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editor's letter

We like to keep ourselves on our toes at Passive House Plus, so readers may notice some editorial changes we've introduced with this issue: a new investigative reporting section called Dispatches, and a technical help desk, manned by the irrepressible Simon McGuinness, who has an uncanny knack for stirring up engaging debate on critical yet anoraky subjects that could so easily make the eyes glaze over in the wrong hands.

As we publish separate Irish and UK editions of Passive House Plus, we're constantly working to achieve a balance between content that's relevant to both Irish and British audiences, and content that's tailored for the specific needs of readers in one market. Thankfully, the laws of physics don't recognise borders, which helps. As does our focus on best practice – and on international standards like passive house – but we also have to pay attention to the issues specific to each market, whether that's BCAR in Ireland or Brexit in the UK. So we've always treated the news sections as discrete to each edition, albeit with some stories overlapping. And advertising is virtually always tailored to one edition or the other. That's much more important for a publication aiming to serve such specific needs as Passive House Plus does. We're not just idly pontificating on how, in an ideal world, buildings should be built. We're actively working to educate and inform readers who are being compelled to choose sustainable building products and services, either through their own volition or the brute force of regulation. So in that regard the advertising in our magazine shouldn't be irrelevant noise between articles. It's a showcase of many of the leading solutions providers available to help make sustainable buildings a reality.

But changes such as the Brexit vote have forced us to consider the potential future differences between the UK and Irish markets, as well as the similarities. While we have similar cultures, construction traditions, climates and, consequently, similar supply chains with much overlap, a likely consequence of Brexit is more deviation on regulatory matters. That's part of what our new Dispatches section will aim to serve.

So in this issue, Dispatches in the Irish edition focuses on our investigative work over Ireland's apparent breaches of the EU directive on the Energy Performance of Buildings, both with regard to the imminent nearly zero energy buildings deadline, and with regard to the failure to adequately tackle overheating, indoor air quality, and the performance gap – all of which can be a real issue in NZEBs, without due care.

Meanwhile the UK Dispatches article focuses on what opportunities exist for progressive local authorities – or even the likes of the Scottish and Welsh governments – to set truly ambitious sustainable building targets in light of the potential policy vacuum that's bound to exist during the Brexit negotiation process, and as a consequence of the last Conservative/Lib Dem government's retrograde decision to remove the powers of English local authorities to set higher energy efficiency standards than building regulations, while curiously U-turning on simultaneous plans to scrap similar powers on councils setting renewable energy requirements.

And for Irish or UK edition readers who want to see what the issues are on the other side of the Irish Sea, fear not: all you have to do is subscribe for a risible sum, and you have access to the digital versions of both editions – complete with handy clickable hyperlinks in adverts, and access to galleries of construction details and plans laying bare the anatomy of the buildings we feature in these pages.

Regards,
The editor

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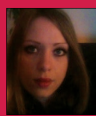
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Disclaimer: The opinions expressed in Passive House Plus are those of the authors and do not necessarily reflect the views of the publishers.

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Photo: Martine Hamilton Knight

ABC

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News

Aereco launches quality standard for its ventilation systems

Ventilation system manufacturer Aereco has announced the launch of its new Aereco Quality Standard.

The company, which designs, produces and supplies demand controlled ventilation systems, is offering the quality standard on projects of any size on which it is engaged right from the design stage.

The company told Passive House Plus that its new quality standard offers: free ventilation design and advice on and off-site (regardless of project size); a certified partner in a contracted agreement to install Aereco systems according to the company's best practice standards; commissioning of the system in-house by Aereco or one of its certified partners; a digital Aereco Quality Standard commissioning certificate; free filter replacement when necessary under the warranty period of the fan; and a warranty extension to five years on systems with a quality standard certificate.

"There are no costs to the Aereco Quality Standard, but a requirement to engage with us from design through to commissioning," said Simon Jones of Aereco.

The standard is available on projects on which Aereco is directly engaged, and/or those delivered by its certified partners.

Jones continued: "Our certified partners have considerable experience in installing our systems and have proven time and again to deliver very high standards of workmanship and professionalism. They are also in contracted agreement to install our systems to our best practice.

"If you do not use them we will support you and your team in achieving the standards required but if the installation or systems does not meet our standards, the Aereco Quality Certificate will not be issued and associated support and extensions of warranty will not be available.

"We believe it is possible to deliver ventilation that works, every time. But it requires a joined-up approach where everyone takes responsibility – and that includes the manufacturer. Demand controlled ventilation provides a unique opportunity to deliver a system with the capacity to meet the ever-changing demands on ventilation. But it can only do that if it's designed right, installed right and commissioned to prove it's right."

Commenting on the launch of the standard, David Adams, technical director of Wilmott Dixon Energy Services said: "There is growing recognition that appropriate and correctly installed and commissioned ventilation isn't simply 'a nice to have' but a prerequisite. It is encouraging to see manufacturers, such as Aereco, responding to this challenge and providing the comprehensive approach necessary to deliver systems that really perform for householders."

Meanwhile David Pierpoint, executive director of Retrofit Academy CIC, added: "This is a genuine and welcome attempt to engage with the supply chain and address many of the problems that have led to widespread failures in ventilation performance noted in recent reports."

"The academy supports initiatives that help to reduce the performance gap. Our retrofit coordinator course provides people with knowledge to manage projects successfully. But well-considered initiatives like this from Aereco are also required to build trust with customers that what they 'get' is what they 'bought.'"

And Paul Kenny, chief executive officer of Tipperary Energy Agency — which runs Ireland's SuperHomes retrofit scheme — said: "Aereco systems are installed as part of SuperHomes deep retrofits. This allows us ensure we can guarantee high indoor air quality for all our clients, which is often overlooked by many retrofit practitioners."

"Aereco's products, design, customer support and contractor training already gives the Tipperary Energy Agency confidence in the indoor air quality of our SuperHomes projects."

(above) A section view of one of Aereco's humidity sensitive air inlets, the EHT, part of Aereco's demand controlled ventilation system solutions

Green Register & AECB launch bite-size passive house training

Although full passive house training is regarded as the best way to gain an in-depth understanding of all aspects of passive house design, some construction professionals may not have the time or resources to be able to attend the typical two week passive house course.

The launch of a series of bite-size half-day technical sessions aims to offer an introduction to the passive house standard, and give an insight into all the main principles of what makes a good low energy, comfortable building based on the passive house standard.

The Green Register and AECB CarbonLite are working together to provide four half-day sessions in Bristol in November. AECB CarbonLite already collaborated with architects Pollard Thomas Edwards to host the sessions in London in September.

All trainers are experts who have successfully designed and built passive buildings in the UK, including: Bill Butcher, Alan Clarke, Sally Godber, Nick Grant, Eric Parks, Marine Sanchez and Mark Siddall, and passive house certifiers Will South, Mike Roe and Peter Warm, as well as passive house designers Tom Dollard and Lucy Pedler.

The four dates for Bristol are: 9 November — passive house fundamentals with Peter Warm; 16 November — construction detailing with Bill Butcher; 23 November — building services with Alan Clarke; 30 November — project workshop and crit session with Nick Grant & Lucy Pedler. For more information about the sessions visit: www.greenregister.org.uk

New research reveals high failure rate for ventilation systems

New evidence indicates that decentralised MEV systems – an increasingly popular option, now that questions are being raised over the standard “background-plus-intermittent extract” ventilation strategy – can also fail to provide adequate indoor air quality, and may even perform worse than the standard approach in new build homes.

Preliminary findings from two new ventilation performance studies were presented at an event organised in June by the Green Register. The studies, by Aecom and Zero Carbon Hub, examined ventilation installation and performance in almost 90 UK new build homes altogether (none were passive houses).

The Aecom research, on behalf of the Department for Communities, initially aimed at investigating the standard approach, but in a number of cases decentralised MEV (dMEV) had been installed instead – despite what was reported for SAP – so the study examined both. The homes in the Zero Carbon Hub study had either MEV (mainly decentralised) or MVHR.

Common issues uncovered with decentralised MEV included: design and/or installation that failed to comply with Part F of the building regulations; complete lack of commissioning – and in some cases, lack of awareness that commissioning was required; “acoustic” commissioning (ie fan speeds set on the basis of noise alone), or suspected “desktop” commission (where recorded air flows were identical to design flows, raising suspicions that no testing had taken place); and inadequate air change rates and poor air quality.

Aecom’s David Ross reported that fan flow rates were sometimes only 25% of requirements – or even lower. With dMEV the same fans were often installed in kitchen, bathroom and toilet, and were unable to supply adequate flow in the bigger rooms without excess noise.

Air quality monitoring in use revealed humidity in some bedrooms to be over 70%. More air quality problems were seen with dMEV: this was installed in only 30% of the sample, but accounted for 83% of the homes with bedroom relative humidity issues. Bedroom CO_2 levels of up to 3000 ppm were recorded (vs the recommenced 1000 ppm), and again there was a much higher CO_2 fail rate in homes with dMEV.

The ZCH research showed similarities in findings, for both MEV and MVHR systems. None had been properly commissioned and none of the six tested dwellings with dMEV achieved more than 50% of the required whole house flow rates. The flow rates in the four tested apartments with MVHR were also below requirements, but by a rather smaller margin.

Residents complained about fan noise, especially when the boost function was triggered in the ensuite bathroom at night – and this led to fans having been deliberately disabled.

Ventilation consultant Ian Mawditt, who worked with Aecom on their research, said architects and designers needed to realise it is their responsibility to ensure properly functioning ventilation is installed. “It will come back to them if there is a lawsuit,” he said, adding that this was not just a remote possibility. “Cases are under investigation even now,” he warned.

Words: Kate de Selincourt

Packed line-up for October Passivhaus Conference & Expo

This year’s UK Passivhaus Conference & Expo takes place on 25 October in the Business Design Centre in London.

The conference programme features large-scale studies from Europe and the UK, new mini-masterclass sessions allowing delegates the chance to get involved with detailed training, and talks from leading practitioners in the UK discussing how to deliver passive house buildings from conception to completion.

Tickets are available, at the time of writing, for the conference - where 450 delegates are expected – and expo, with extra tickets available for attending the expo only, where visitors will have the chance to talk to over 20 of the leading brands involved in passive house design and construction, including conference gold sponsor Rehau, silver sponsors Cygnum and Kingspan, bronze sponsor Green Building Store and drinks sponsor Zehnder.

In the first half of the UKPHC16 conference programme, keynote speakers Jessica Grove-Smith of the Passive House Institute and Ralf Bermich of Leiter Energie und Klimaschutz will discuss some of the largest passive house developments in the world, as well as the latest international projects that have been built to the new passive house standards — passive house plus and passive house premium.

This will be followed by a panel discussion and a summary of exciting large-scale projects in the UK that are under development such as the Elephant Park regeneration project in London and monitoring studies at Leicester Medical Centre, the UK’s largest certified passive house project.

The second half of the conference programme is split into two streams:

The first, ‘Getting it off the ground’, will look at early design decisions such as site selection, orientation and planning; making the business case for passive house to clients; and setting-up the appropriate project team to deliver a project from start to finish.

The second, ‘Getting it built’, will will look at quality assurance, making sure the construction phase of a project is delivered on time, on budget and to the highest performance standards; and monitoring and measured data for large and small-scale projects.

In the final session of the day, Chris Herring will host a Q&A session with a panel and attendees to discuss what steps are required to delivery the necessary quality for passive house at scale in the UK.

To see a full programme and to book your conference and expo tickets, visit www.ukphc.org.uk

(below) London’s Business Design Centre, the venue for this year’s UK Passivhaus Conference and Expo

News

AECB members praise Passive House Plus for content and advertising

Passive House Plus has been widely praised for its editorial content, technical information and the relevance of its advertising in a survey of members of the AECB, the UK's largest sustainable building association in terms of membership numbers.

The survey was of individual supporters and student members of the AECB (Association of Environment Conscious Building), rather than businesses and organisations, which are due to be covered by a separate survey later this year.

Respondents praised the magazine for its writing, information on new products and its technical details and photography.

"This magazine gets more interesting with every issue. It is superbly illustrated and the editorial is excellent. It keeps me up to date with developments and products," one respondent said.

"Provides a good overview of the products on the market – some of which I might be looking to incorporate in my future building project," said another respondent, while another added: "Excellent articles. Interesting to see international projects. Advertising relevant. Would like to see more good quality construction details."

Several respondents praised the magazine not only for the production standards or case studies, but even for the quality and relevance of the advertising. "Excellent. Particularly valuable for the passivhaus-specific ads," said one respondent.

"Excellent mag - good industry updates, inspiring stories, lots of practical tips and advice, and I like the performance stats that accompany the main stories," said another.

A full list of the responses from members, published anonymously, can be found at the bottom of this article. Some AECB members, however, did offer criticism and suggestions for how the magazine could be improved.

"Its coverage is excellent," said another respondent. "Sometimes the journalism could be better. Very important to cover case studies in depth and to show what individual materials and specifications achieve."

Some called for more technical content in the mag, while others were either not aware that technical drawings for projects featured in Passive House + are available online for subscribers, or suggested that this feature could be improved.

"It's good," said one respondent. "A little less broad than Green Building magazine, and it would be nice if they put technical drawings in sometimes, rather than having them exclusively online."

"Maybe it needs more non-domestic projects and not only houses/dwellings," said another.

The UK edition of Passive House Plus is now the official partner magazine for the AECB, after the long-running publication Green Building ceased publication last year.

To view the full list of responses visit http://bit.ly/2dPG3XS

Kingspan's Stormont solar array meets unique challenges

Home of the Northern Ireland parliament in Belfast, Stormont has recently undergone a major refurbishment, including a completely new plumbing and heating system that provides catering and washing facilities on a daily basis for over 1000 people. The building itself has changed little over the years (it was opened in 1932) and therefore presented an interesting design and installation challenge.

As a prominent public sector institution, renewable, low carbon energy had to be specified as a required element of the new building envelope. While the huge expanse of flat roof space – orientated north/south with minimal shading — lent itself ideally to solar thermal panel technology, the calculation of the maximum annual hot water demand (bearing in mind possible seasonal discrepancies) was critical. When it came to demonstrating the green credentials of the Northern Ireland Assembly, the hybrid system would not only have to deliver sufficient hot water, but also give the expected return on an investment, entirely funded from the public purse.

The partnership of leading renewables manufacturer, Kingspan Thermomax (part of Kingspan Environmental Ltd), mechanical consultancy Bennett Robertson Design and installation contractor Alternative Energy Ireland (AEI) provided all the necessary expertise and resources to design, specify and build the solar thermal hot water system. At the 2016 Action Renewables Association Awards, the Northern Ireland Assembly won first place as the best renewables installation within the education, healthcare and public sector.

Flexibility was a key requirement for the solar array solution because of the structural challenge presented by the 85-year-old flat roof. High winds had to be factored in because of the location of the building, meaning that solar panels were laid effectively flat, at 2 degrees to the horizontal, as opposed to standing at the usual 35 degree angle to the roof. The compromise in energy output was deemed acceptable when set against potential wind damage to the collectors.

Managing Director of AEI, Steven Bray said. "We always choose to work with Kingspan as we find the quality of the products are second to none plus the fact that their technical staff are involved with the project from initial specification right through to completion. They are always available and able to deal with any question or on-site problem. Typically, you will find Kingspan Thermomax product being used on the more 'interesting' projects because of its flexibility and reliability."

For further information visit www.kingspanthermomax.com

(above) A solar thermal array consisting of 360 Kingspan DF100 tubes was installed on the flat roof facing south at Stormont, the Northern Ireland parliament building

News

Integrated passive services installed at Shropshire naked house scheme

Prefab passive house specialists naked house Ltd recently completed the installation of a fully integrated passive house services system at their Marsh Road project in Shropshire. MVHR and solar thermal system are a standard part of the naked house system, with extra optional modules to enhance the building's potential to save the occupants' running costs. At Marsh Road, this included a log burner, thermal store and central logic control system.

The Marsh Road passive house has been built using the pre-fabricated 'naked house' timber frame system, with electrical ducting and plumbing pipes built-in at the factory to minimise disruption of the building fabric on site, and with ventilation pipe runs designed in at the drawing board phase, and factory-prepared for ease of installation on site.

The services at Marsh Road were designed to minimise the cost of heating the house through a combination of a 1500 litre heat store, with various heat inputs, to optimise the heating cost through the year.

Six drain-back solar thermal panels feed into the heat store and these provide the majority of the heating throughout the year, the drainback system preventing any summer overheating problems with the panels.

A log burner is employed for the cold sunless winter days where the output from the six solar panels is at its lowest. A small 12kW Vaillant gas boiler acts as a backup in case there's no sun and no logs. The entire system is controlled by a central programmed Resol controller.

"The choice of log burner is critical," said Benjamin Nickell of naked house. "Airtightness is important and a separate air feed from outside is essential.

"The heat store is necessary to store the heat from running the log burner in the evenings only, and absorbing the 6kW output for use when required later. The log burner may only be required to run in the evening of those sunless days during the cold months of the winter. The heat store contains a 400 litre hot water cylinder inside, which keeps the family with hot water throughout the year."

The heat stored in the thermal store is distributed through the house by means of an air/water heat exchanger from the heat store to the supply air to the house via the MVHR, and also to three towel rails from the same source.

"A heat store of this volume can keep a large passive house, like this one at 225 square metres, warm for three or four days, and with intermittent sun and log supply no additional gas should be necessary to heat the house throughout the year. Heating bills will therefore be minimal," Nickell said. Summer overheating is controlled by automatic external solar blinds and a summer by-pass in the ventilation system.

(left) The Marsh Road passive house features six drain-back solar thermal panels feeding into a thermal store

Researchers find toxic particles from air pollution in human brain

Leading construction testing and research organisation BSRIA has announced that it is concerned with recent findings that toxic nanoparticles from air pollution have been discovered in human brains in "abundant quantities".

Tiny magnetic particles from air pollution have for the first time been discovered to be lodged in human brains – and researchers think they could be a possible cause of Alzheimer's disease. However, the new work remains a long way from proving that air pollution particles cause or exacerbate Alzheimer's.

Researchers at Lancaster University found abundant magnetite nanoparticles in the brain tissue from 37 individuals aged three to 92-years-old who lived in Mexico City and Manchester.

This strongly magnetic mineral is toxic and has been implicated in the production of reactive oxygen species (free radicals) in the human brain, which are associated with neurodegenerative diseases including Alzheimer's. Air pollution has been shown to significantly increase the risk of the condition.

Air pollution has also been linked to dementia in older men and women. Julia Evans, chief executive of BSRIA, said: "These are deeply concerning results but clearly more research and information is needed at this stage. But it does confirm early stories that air pollution can affect wellbeing and cognitive performance.

"Degenerative brain diseases such as Alzheimer's, mental illness and reduced intelligence are indeed cause for unease. And it is deeply worrying that outside air quality is the same as that inside. As an industry we have a role to play in providing a safe indoor environment."

(right) BSRIA CEO Julia Evans has described the findings as "deeply concerning"

News

MBC Timber Frame opens new Gloucester factory

MBC Timber Frame has announced the opening of its new manufacturing and design premises at Quedgeley Court, Gloucester. The company told Passive House Plus that it has the capacity to manufacture 50,000 to 60,000 square metres of passive housing per year at the new facility.

MBC's Timber Frame's Joe Blair told Passive House Plus that its timber frame wall system can deliver U-values from 0.20 W/m²K right down to 0.10. "Most of our passive house clients opt for a 0.12 U-value twin-wall and 0.10 U-Value roof system," he said. "In our factory we fit the Propassiv airtight passive-certified OSB board, and once on site we pump Warmcel into the wall and roof cavities."

He added: "MBC was formed in 2002 in Ireland, where we recognised there was a move towards energy efficiency. In 2007 we built our first passive house in Tipperary, Ireland and in 2011 we sold our first passive house in the UK. Since then we have concentrated our efforts on the passive house market in the UK."

"With the ever-growing demand for passive housing I took the decision early this year to open a manufacturing and design facility in Gloucester so that we could provide a more efficient service to our client base in the UK," Joe Blair added. For more information see www.mbctimberframe.co.uk

(below) Passive house and low energy specialists MBC Timber Frame's new premises in Gloucester

Eco Heat: prevent overheating from solar systems in passive houses

Leading renewable energy experts Eco Heat & Power Ltd has advised those installing solar hot water systems in low energy houses to do so in a manner that prevents overheating and protects the building's thermal envelope.

The company's Andrew Hodchild has worked periodically with the Green Building Store, and installed the solar thermal system at Denby Dale, one of the UK's first certified passive homes.

"The main issue I have learnt from installing solar heat in passive houses is that incidental heat gains, particularly in mid-summer, from either pipework or the cylinder need to be avoided to stop overheating which may lead to discomfort or the MVHR over-working," Hodchild said.

"To this end I have obtained cylinders with 100-150mm lagging and use high quality thick lagging on the solar transfer pipes. Fitting these systems during construction is always the best way, and with passive house it's even more important as you have to penetrate the envelope of the building at some point," he said, emphasizing that this work should be done in collaboration with the builder or a specialist to ensure that airtightness is maintained.

"It can be more difficult if the main envelope includes the roof as the pipes close to the collectors can get very hot indeed, particularly when there's no demand for hot water."

He continues: "At Denby Dale, the thermal envelope stops at the floor of the loft so it's easier to penetrate the envelope, at loft floor level, where the pipes may be cooler and weathering has already been dealt with at the roof line."

This contrasts with the Golcar passive house (featured in this issue of Passive House Plus), where Eco Heat & Power Ltd retrofitted a solar thermal system onto a building in which the thermal envelope included the roof. "I use Armaflex HT solar insulation fitted tight to the pipe passing through the envelope. For non-roof penetrations I might use foil backed Rockwool, with grommets and sleeves through the fabric membrane and insulation."

Hodchild said users can maximise the efficiency of their hot water setup and help to avoid overheating by only using on-demand hot water (from their boiler or immersion etc), rather than setting a timer, or by only setting the timer to heat water at sun down, so it's used that evening and the following morning — leaving a cold tank in the morning for the solar thermal to heat.

This approach applies to summer and to some extent spring and autumn. "In winter you may want to go onto timed heating of hot water," added Hodchild, who also advised of the importance of not oversizing systems, and suggests upgrading cylinder size first, rather than increasing the number of collectors.

(below) Eco Heat installed a solar thermal array (pictured above the PV array) at the pioneering Denby Dale passive house


Photo: Morgan O'Driscoll

News

Building designers must start to think about overheating — YDB

Passive house design and product supplier Young Design Build (YDB) has advised anyone building or renovating to pay careful attention to the need for cooling in low energy buildings, pointing to the fact that the EU's policy on nearly zero energy buildings requires cooling to be considered as part of the energy calculation as an indication of the seriousness of the issue.

Stephen Young of Young Design Build told Passive House Plus: "The recast 2010 Energy Performance of Buildings Directive specifically states within its general framework that the energy performance of a building shall be determined on the basis of the calculated or actual annual cooling energy needs [energy needed to avoid overheating] to maintain the envisaged temperature conditions of the building.

"With more energy efficient buildings now being constructed summer overheating shall become or may already be a health hazard for vulnerable people in our society. The occupants of low energy or passive house buildings may have a misconception that opening of windows during the day time will provide cooling and lower the internal temperature, but this can actually exacerbate the overheating when the external temperature is higher than the internal temperature."

Young pointed out that the Passive House Planning Package allows for night time cooling and contains warnings when high levels of glazing could lead to overheating.

Young continued: "Prevention of summer overheating is obviously the best solution but in many instances an existing house or building sites in urban areas do not allow you to alter the building's orientation, or reduce the glazing area facing south-west to north-west where low sun late on a summer's day can cause overheating."

He added that YDB provide an external blind solution to prevent overheating by solar gain which can be automated to close when an internal temperature limit has been reached via a connected BMS system. "The external blinds can be retrofitted to existing buildings, or discretely designed into new build, and are far more effective than a horizontal brise soleil because they shade the entire window area."

"The blinds are transparent and allow the user to view the external space during the day, and if closed during the night can improve the U-value of the window."

(left) A transparent external blind from Young Design Build

Potton opens UK's first permanent passive show home

Self-build specialist Potton has officially opened the doors to the UK's first permanent self build passive house show home at its dedicated show centre in St Neots, Cambridgeshire.

The much anticipated show home, which has been designed to achieve the passive house standard, will be the company's sixth and most contemporary show home to date.

In a weekend of celebrations to mark its opening, the team at Potton played host to over 300 aspiring self-builders who were given an exclusive preview to the new contemporary show home.

Potton said that part of the motivation for constructing the home was to dispel the myths often associated with passive house builds, for example that, "you can't open the windows, the air inside is unhealthy and the ventilation system is noisy and expensive to run".

The show home was designed by HTA Design LLP. Commenting on the opening Potton's self-build director Paul Newman said: "We are extremely excited about the opening of our new show home.

"As our most ambitious show home yet, we wanted to not only encourage prospective self-builders to consider the benefits of building a passive house but also to give them a real feel of what can achieved, both in terms of the limitless design options and the outstanding functionality of a low energy home of this kind."

Newman said that Potton is committed to educating people on all things self-build including the complexities and benefits of building a passive house and living a low energy lifestyle.

"The project has seen significant collaboration between our supply chain partners and together we have created something we can all be pleased with," he said.

Potton's new show home, together with its four other stunning show homes, will be open for viewing weekly from Tuesday-Friday (9am-5pm) and Saturdays (10am-4pm).

For more information visit: http://www.potton.co.uk/our-show-homes/

(right) Potton's permanent passive show house in Cambridgeshire has opened its

News

Ecological Building Systems appoints technical support engineer

Sustainable building products distributor Ecological Building Systems continues to develop its service to customers with the appointment of Ilias Igoumenidis as technical support engineer. In a statement, the company said his knowledge of sustainable building products will prove invaluable in assisting customers in design and product selection.

A member of the Technical Institute of Greece, Ilias gained significant technical and managerial experience in all areas of building project development at the family firm, one of the largest construction companies in north-west Greece.

Ilias is currently studying for a masters in real estate development at the University of Salford's School of the Built Environment, specialising in valuation and investment appraisal, project management systems, and the design and development of energy-saving sustainable projects. He is a partner in the Hellenic Passive House Institute, and the first member of the institute to attain certified passive house designer status.

Ilias will now use this experience and knowledge of the sustainable construction market to assist customers with the design of projects and use of Ecological Building Systems' wide-ranging portfolio, which includes Pro Clima air and wind-tightness solutions, Gutex insulation, Calistherm climate board and Diasen thermal plasters. He will also work with the team at exhibitions and conferences, provide presentations through Ecological Building Systems' CPD programme and support stockists and distributors.

Penny Randell, UK director of Ecological Buildings Systems commented: "Ilias is a great addition to the team. He has an enviable track record in sustainable and passive house construction, and his wealth of technical expertise and experience will undoubtedly make him a valuable resource for our customers."

Ilias commented: "I'm really looking forward to providing technical support to our customer base, primarily architects and contractors, advising them on the unique attributes and benefits of our product portfolio and how to incorporate them into their constructions."

Ilias started his new role with Ecological Building Systems (UK) Limited on 1 August.

(above) Ecological Building Systems new technical support engineer, Ilias Igoumenidis

New passive house firm Enhabit aims to revolutionise retrofit

Enhabit, a new specialist passive house firm, has launched with the aim of leading a step change in how the energy efficient retrofit of buildings is delivered in the UK.

Enhabit aims to focus on the considerable comfort and quality elements of passive house building, providing a full service from architectural and passive house design, to project management, construction and handover. "A full design and build contract, which involves a single entity taking responsibility for the complete process makes passive house easier to achieve, as there's nothing that can fall between the gaps," says John Palmer, managing director of Enhabit.

With more than one quarter of the UK's carbon emissions coming from the houses we already live in, and recognising that 75% of the homes that will exist in 2050 have already been built, there is a real need to build momentum retrofitting older homes, to bring them much closer in performance to modern day standards. Enhabit specialises in the retrofit of existing buildings to passive house standards.

Brandon Lewis, who was at the time minister of state for housing and planning, attended Enhabit's launch event, and said: "Enhabit's objective of enhancing the energy efficiency of homes is also critical in terms of meeting the UK's carbon emissions targets as well as tackling fuel poverty to help vulnerable households."

With a team made up of building physics engineers, building services engineers and architects with proven industry expertise in delivering energy performance, Enhabit will work to transform uncomfortable and wasteful buildings into comfortable and controllable living and work spaces.

Mark Clare, formerly chief executive of Barratt Developments plc, an investor and non-executive director of Enhabit, said: "The launch of Enhabit reflects the huge opportunity that exists for the private sector to get involved in improving the performance of homes and work spaces. Enhabit has already built a strong track record as an expert in its field and has delivered real improvements for its customers. Its aim is to ensure it is best placed to play a larger role in this growing market and the team at Enhabit have a real passion and desire to push forward and lead the way."

Enhabit has grown from Green Tomato Energy Ltd, which has helped many homeowners, architects and businesses to create genuinely energy efficient buildings. The group's past projects include the first Enerphit retrofit in London and the first two passive house retrofits in the UK, winning the CIBSE Award for energy efficient buildings.

(above left) Enhabit acted as passive house consultants on a Paper Project Architecture and Design passive house in Claygate, Surrey; (inset) Enhabit investor and non-executive director Mark Clare

News

Bow Tie become silver partners with Loxone Smart Home

Low energy builders Bow Tie Construction have joined up with Loxone Smart Home to become silver partners, enabling Bow Tie to design Loxone systems and install the company's home automation products.

Bow Tie technical director Rafael Delimata explained why: "For quite a long time we felt that there were no specialist tools to help us optimise and control services in homes. We felt that the available systems were expensive and did not effectively integrate all items such as lighting, the burglar alarm, audio, heating, hot water, solar, solar PV, automatic blinds, actuated windows, MVHR settings, etc. Some smart home systems concentrate on lights, some on AV, some on blind controls. We love that Loxone allows us to integrate all these systems without compromise, and it is the most affordable product in this market." All home controls are rolled up into a single personalised app for the occupiers that they can install on smart phones and tablets.

"We were also looking for a system that would feed back usage and consumption data to us so we could remotely optimise the client's M&E system settings as a part of our aftercare service," said Delimata. "We want to compare power consumption with output to ensure the M&E system is functioning efficiently and not working hours when it is not needed, which will save on wear and tear. We want to use Loxone for real-time background fault reporting."

He continued: "Data collected on the running of properly functioning equipment would be automatically compared to current running data and any disparity would be flagged. Errors on flat batteries, damaged gears in a garage door, a blocked flue in the boiler, low pressure in the heating system, blocked MVHR filters could all be detected before they become serious problems. We would then advise the client and arrange a date to visit and fix.

"At present every M&E system is over-specified, just in case. We want to be able to tune in to our client's needs and occupied usage to optimise the system for them and reduce unnecessary energy usage and expense. Collecting this data over the long term will help us specify appropriate systems for future clients and ensure that they don't spend more than they need to.

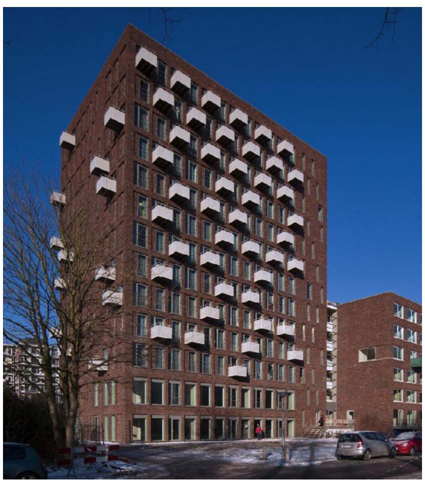
The company is currently installing a Loxone system in Bounds Green, North London, where its primary function is smart metering. "The property is split between a shopfront retail unit and a residential home," said Delimata. "This system will allow utility costs to be split without going through the costly and time-consuming process of asking each utility company to provide a separate supply."

More information on the Bounds Green project is available at www.bowtieconstruction.co.uk

(below) A Loxone system being installed by Bow Tie Construction at Bounds Green, North London

WWHRS recovers 58% of shower heat at Dutch student complex

Uilenstede, an award-winning student apartment building in Amsterdam, owned and operated by the student housing corporation Duwo, has achieved huge savings in hot water costs thanks to the installation of a suite of waste water heat recovery systems (WWHRS). Recoup WWHRS supplies these same WWHRS units into the UK and Ireland.



Duwo is the largest student housing corporation in the Netherlands, with over 30,000 rooms and houses across the country. In this development of 110 one-bed studio apartments, 102 vertical WWHRS pipes and eight horizontal WWHRS integrated shower trays were installed back in 2014. The project has now been monitored for two years as part of a 10 year monitoring programme.

Each of the studio apartments has a dedicated heat interface unit for space and hot water heating, via the centralised district heating system. In all, ten apartments have in-situ monitoring equipment. The WWHRS pipes are located in service compartments which are accessible from the communal corridors, with the WWHRS integrated shower trays located in the ground floor.

Monitoring results so far show that on average the WWHRS units are recovering 58% of heat energy that would otherwise be washed down the drain, and returning it to the domestic hot water system.

Since showering makes up the largest part of the hot water budget in these self-contained student dwellings, the total energy requirement for hot water has been reduced by over 40%.

Readers sought for monitoring study

Meanwhile, Recoup is also currently seeking readers with ongoing building projects to participate in a period of monitoring after installing one of the company's WWHRS units. Recoup is seeking suitable projects, in which the building owner would be willing to install and monitor a WWHRS system, with the results set to be published in Passive House Plus at a later date.
For more information contact ellis@recoupenergysolutions.co.uk

(left) Monitoring studies at Dutch student complex Uilenstede show the WWHRS recovering 58% of heat energy from shower trays

News

Airflow MVHR systems installed at UK's largest affordable passive scheme

High-performance MVHR units from Airflow Developments are set to feature at Saffron Acres, a social housing development in Leicester that is expected to be the largest affordable passive house scheme in the UK.

Built on a former derelict allotment site belonging to Leicester City Council, Saffron Acres is a 13-acre affordable housing scheme situated off Whittier Road and Heathcott Road in Leicester. Sold for the nominal fee of £1 to emh homes with a view that the housebuilder and appointed property developer Westleigh provide affordable living to the area, the development will predominantly feature semi-detached houses, as well as four one-bedroom flats and two bungalows, with all 68 dwellings aiming for the passive house standard.

Giovanni Corbo, business development manager at Westleigh, commented: "Leicester City Council challenged Westleigh and emh homes to provide an exemplar development, so it was logical to choose passive house as the standard we wanted to achieve. Airflow and DR Ventilation have proved invaluable by helping us to select the appropriate passive house approved MVHR system and design duct layouts that can easily be accommodated and installed within our dwellings."

Passive House consultants Encraft were employed by Westleigh for the project, and specified Airflow Developments' state-of-the-art Duplexvent MVHR units. "We need to use passive house certified units because otherwise you receive a penalty when you undertake the energy modelling," said Dr Sarah Price, senior consultant at Encraft. "Airflow's DV96SE unit is ideal because it has a 100% effective summer bypass mode, which allows cool air in automatically in the summer; a post-heater that provides 50% of the space heating and frost protection integrated so the unit doesn't freeze in the winter."

Jason Bennett, specifications manager at Airflow, adds: "An effective MVHR unit is capable of extracting harmful indoor air pollutants and providing fresh, healthy air whilst recovering valuable heat energy. When designing eco-friendly, affordable homes like the ones at Saffron Acres it is imperative that exemplary, preferably passive house approved, MVHR units are specified to help achieve optimum build standards, maximise internal comfort levels and reduce energy wastage."

The Saffron Acres development is scheduled to be complete late 2016. To view a video case study on the project, visit tinyurl.com/airflowMVHR. For further information on Airflow's MVHR systems and ventilation products visit: www.airflow.com

(left) Work progresses at Saffron Acres; the scheme features Duplexvent Passive House Institute certified MVHR units

Stephen Gurney joins Eden Insulation

Passive House modular timber frame manufacturer Eden Insulation has announced that Stephen Gurney has joined the company as co-owner and director. Gurney previously spent six years working as technical manager for Ecological Building Systems in the UK. "I had a good background in insulation, airtightness and passive house, having travelled all around the UK advising on projects," he said.

Gurney had previously supplied products to, and helped develop new systems for Eden Insulation in his role at Ecological, and was impressed at how Eden built with their modular, prefabricated timber frame system. "Nobody else was building like Trevor Lowis at Eden Insulation," he says. "I was very interested in the way he was working."

Gurney was eager for a new challenge and a more direct role in constructing passive house and low energy buildings, and ended up buying into the company and becoming co-director. "I was just so convinced by the way Trevor is building, I thought right, I want to be involved in that."

"We can build any type of buildings. We take architects' plans and adapt them to our timber frame system," he said. "We make individual panels which are airtight on the inside, wind-tight and weather-tight on the outside, but diffusion open. We use natural materials whenever we can."

The company's pre-fabricated panels are then craned into place on site in a lego-like fashion. "We generally can assemble a standard building within a day, and then we have a couple of days of wind/airtightness sealing," he says. "After three days when we drive away, you've got a weather-tight insulated frame, bar the windows and doors going in."

The company has so far built six passive houses, one being Enerphit, as well as a plethora of other low energy buildings, with more passive buildings due to go on site next year.

(right) Stephen Gurney, Eden Insulation's new co-owner and director

News

Sustainable buildings must engage our emotions, AECB conference hears

Have you ever had one of those moments of immense clarity when things just slot into place in ways that they have never done before? I'm guessing you have. In my experience they happen at random points in time. They are completely unexpected. I had one of those moments at the AECB Conference this year, but before I tell you any more about it I'll tell you about the things that led to that pivotal moment.

First a little context. The AECB 2016 national conference was held at the University of East Anglia (the second time it's been held there). Whilst it may be one of the UK's most inaccessible universities it remains a hot bed of thoughtful and considered building design. The focus for this year was the ADAPT building.

ADAPT stands at the gateway to the campus and facilitates teaching, private tenants and events by providing cellular spaces and areas of open plan, plus a modest auditorium. We were told what sets the building apart is the fact that it is East England's greenest business hub. These days claims such as these justifiably cause people to baulk as they feel more than a twinge of cynicism (or perhaps that's just me.)

So it's with a healthy dose of scepticism we learned how the brief for the building set challenging sustainability targets. It has a 100-year design life. It achieves BREEAM Outstanding. There was intense consideration of the local supply chain and considerable effort put into sourcing materials from the local area. Materials were selected to minimise the use of embodied carbon. It uses natural materials (including 300 panels of thatch). It was designed to accommodate deconstruction and demolition. The building achieved the passive house standard. Finally add to this cocktail a good dose of soft landings.

All tallied up it reads like a checklist of nice to haves. But does it really work?

In short, my scepticism was left at the front door. As an experience the building is a delight. It's light and airy. Okay the ventilation in the auditorium was pushed to its limit on a couple of warm summers days but apart from that it was, in my experience, nothing less than a joy. The journey was worth the trip for that experience alone. Compliments to UEA, Architype and Keepmoat.

The Carbonlite Retrofit Standard (CLR) took centre stage at the conference again. The training programme acts as a bridge between 'make do' and best practice retrofit. It is about creating solid foundation of understanding for professionals that work with existing buildings day in and day out. By underpinning the work of building professionals it is possible to avoid long term unintended consequences that could have costly implications. This flagship programme has been through the pilot phase and it now in general release. So if you work on existing buildings regularly and would like to discover more about how to retrofit buildings properly then go to goo.gl/h9sOsw.

This year's conference featured deep dive workshops tackling subject areas including ventilation and airtightness. I worked with Paul Jennings – a fellow trustee of the AECB – to host the airtightness workshop and assemble the airtightness demonstrator. In addition to making our own contributions we heard from master builder Mike Whitfield, Liam Schofield and Chris from Nesthaus and Ognjen Ristic of Barisa Ristic. Key lessons included:

- airtightness is only one aspect of air movement that can undermine performance;
- under no circumstances should duct tape be considered suitable for creating an airtight seal;
- three-metre rolls of membrane are easier to install and require less labour;
- contractors that treat trades as a commodity do a disservice to the client and the respective trade (particularly airtightness professionals);
- when creating an airtight building you must be constantly vigilant for mistakes;
- without a sound design and robust specification good standards of airtightness are virtually impossible;
- The contractor should appoint an airtightness and thermal integrity champion (Attic); They should be on site every day and should be the primary point of contact for all things relating to insulation and airtightness;
- continuity of labour is a prerequisite.

Building upon last year's popular talk, Nick Grant of Elemental Solutions delivered a tour de force on his favourite subject — value engineering. Delivered with humour and irreverence, Nick's call to arms was certainly one of the highlights.

Liz Male gave a sizzling presentation that focussed upon how we communicate sustainability. One thing is for certain, the marketplace is changing. ISO 14001 (environmental management systems) and ISO 45001 (occupational health and safety) are aligning. The Advertising Standards Authority has taken a view on how words such as 'eco' and 'sustainable' may be used. As the marketplace evolves, the old days of arguing 'green is good' are rapidly fading onto the horizon. Furthermore, the public are becoming jaded by doomsayers that threaten environmental catastrophe (even if it is true). Hell does not sell. We are seeing new and emerging expectations.

To communicate successfully we were told we need to return to the basics. We need to engage people at a visceral emotional level. We need to start telling engaging stories about how lives are being transformed, people are being empowered and how our client's undertakings are heroic. By focussing upon the virtues and the fundamental benefits of the buildings we create, by collecting data and evidencing proof we can demonstrate that sustainable buildings are better buildings and better homes.

And this was my spear in the chest moment. The flash of light if you will. The future of sustainable construction will succeed not based upon selling logic and technology. The left side of the brain will not triumph over the right. The future of sustainable construction will succeed by engaging people's emotions and by creating well-crafted buildings people fall in love with. Sustainable construction will succeed by creating lovingly engineered architecture.

The AECB (Association for Environment Conscious Building) helps individuals and companies build and share knowledge about sustainable and green building including passive house and low energy construction. To find out more about the AECB and how membership will benefit you, go to www.aecb.net

Words: Mark Siddall

(above left) UEA's Enterprise Centre, the venue for this year's AECB Conference; Dr Tina Holt presenting on the AECB's Carbonlite Retrofit course

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Upgrade/extension to a commercial/public building ☐

Other (please state): ______________________

Floor area (approx. ft² or m²): ______________________

Budget (approximate): ______________________

Stage (tick box)

Initial appraisal ☐ Pre planning ☐ Planning approved ☐ Pre tender ☐
Commencement notice ☐

Project imperatives (tick box)

Certified passive ☐ Near passive/low energy ☐ Indoor air quality ☐ Low running costs
☐Low environmental impact ☐

Other (please state): ______________________

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Who needs retrofit standards?

We all do, argues Dr Peter Rickaby, but the goal of mass retrofitting our energy inefficient building stock is hampered by the fact that when it comes to most retrofits, we simply don't know what we're trying to achieve.

If we in the UK and Ireland are to meet our national emissions reduction commitments we must improve at least twenty million UK homes and one million Irish homes by 2050, and we have to do it properly, but very few of us engaged in retrofit (except those delivering Enerphit, the passive house retrofit standard) seem to know what we are trying to achieve. Are we aiming to reduce fuel costs, reduce fuel use, reduce emissions, alleviate fuel poverty, eliminate condensation and mould, or all of these? And by how much? Is it 80%, or 60%, whatever is funded, whatever we can manage or whatever is not too challenging? I have seen projects adopt all of these approaches. Our national objectives need translating into retrofit standards, because if we leave people to decide for themselves what standard to work to, the outcome is unlikely to be good enough.

> "Much recent retrofit has not delivered the expected savings, and has been of such poor quality that damage has been done to buildings and occupants' health has been put at risk."

We should begin by addressing fuel poverty. People who cannot afford to keep warm and have mouldy homes are not interested in reducing emissions, so eliminating fuel poverty comes first. There is little point improving homes to deliver affordable warmth now, because we know that fuel prices will rise after 2020, so with a view to 2030 we should be improving homes to at least the top of energy performance certificate (EPC) band C, a SAP energy rating of 80. The UK fuel poverty regulations encourage landlords to improve homes out of EPC bands F and G, but unless those homes are improved to SAP 80, the investment will be worthless in a few years as fuel prices rise.

There are some energy standards for retrofit. The building regulations include elemental standards (maximum U-values for building elements and minimum efficiencies for services) but there is no whole-building standard. Enerphit provides a comprehensive, detailed, whole-house standard that comes close to 80% emissions reduction, but even passive house enthusiasts acknowledge that Enerphit can be too challenging. Good practice is probably somewhere in between, but the STBA (Sustainable Traditional Buildings Alliance) and others tell us that deep retrofit of older, traditionally constructed buildings is not prudent. *A Bristolian's Guide to Solid Wall Insulation* suggests that internal solid wall insulation should not exceed 60mm thick, achieving a U-value of just 0.6 W/m²K.

The most persuasive argument I have heard about emissions reduction is that if we wish to reduce emissions by 80% we should retrofit every building to the best standard we can achieve, to compensate for the many buildings for which the best we can do won't come close to 80%. However, we learned from Innovate UK's Retrofit for the Future programme that reducing emissions by 80% costs approximately £90,000 per dwelling, one-off, or perhaps an average of £50,000 at scale. Because of the law of diminishing returns reducing emissions by 60% costs half as much: £25,000 per dwelling at scale. Reducing average domestic emissions by 60% will probably be enough if we can de-carbonise the electricity supply system sufficiently to deliver the other 20%.This seems plausible, and ignoring the supply-side contribution would be foolish. So 60% emissions reduction looks like a good standard to work to, provided we accept that it is an average. Eighty per cent or more is better, where possible.

Much recent retrofit has not delivered the expected savings, and has been of such poor quality that damage has been done to buildings and occupants' health has been put at risk. Often these problems have resulted from poor assessment, poor design (or no design), failure to consider the interactions between measures, poor installation, lack of proper commissioning and inadequate hand-over. We need whole-building retrofit standards that protect the health and welfare of occupants and the integrity of the buildings by dealing with the end-to-end retrofit process in detail. The Irish domestic retrofit standard, NSAI SR54:2014, provides a good starting point – it is comprehensive, technically sound and readily accessible as a free download to anyone in the industry.

The current UK standard for retrofit, PAS 2030:2014, was originally developed to support the Green Deal and the Energy Company Obligation (ECO), and was driven by ministers' justifiable paranoia about 'cowboy builders'. Consequently, PAS 2030 has little technical content, its focus is on installer competence. PAS 2030 is now being revised to support the next round of ECO. Design requirements are being introduced, and there will be material on the interactions between measures – both physical junctions and functional interfaces such as between insulation, ventilation and heating.

However, we still need robust, comprehensive and appropriate technical standards for retrofit. The quality criterion should not be whether the installer has been certified competent but whether the whole of the work carried out, from inception to handover, complies with such standards.This is the vision of BSI's Retrofit Standards Task Group, working alongside the implementation of the 'Each Home Counts' (Bonfield) review to develop a framework of new and existing standards to support a national retrofit programme. It's a big task.

Dr Peter Rickaby is director of Rickaby Thompson Associates Ltd, a trustee of the National Energy Foundation (NEF) and chairs the BSI Retrofit Standards Task Group. The views expressed here are his own, and not necessarily endorsed by the NEF or BSI.

Our passive journey:

Designing our family's passive house

In the third instalment of Nessa Duggan's column on designing and building a passive house for her young family, she describes the process of designing a house to suit the family's lifestyle.

In designing our passive house, we need to fuse our needs for a functional family home with aesthetic preferences, passive house principles and outline planning constraints into a house design and successful planning application. At the outset, the estimated time to prepare the application was three months.

Our architect asked us to prepare a written brief listing our wildest possible dreams, and including images of likes and dislikes, on the understanding that he would do his best to fit it all in. Having weighed up the pros and cons of the many potential houses we have viewed over the past two years, we had a good idea of what we wanted, and what we didn't.

> "While house hunting prior to buying the site, Donal would write off most dormer style houses as his head banged off sloping ceilings."

Challenging the storey-and-a-half design condition on outline planning was a huge priority for us. Apart from issues associated with airtightness and efficient insulation of dormer features, my husband Donal is over six feet tall and our three boys are all stretching upwards at an alarming rate. While house hunting prior to buying the site, Donal would write off most dormer style houses as his head banged off sloping ceilings. We also initially put a floor area cap at 250 square metres, because we didn't want to live in a big rambling home (with the associated housework), and because this size fits our budget.

With this project we are planning our 'forever home', and knew from our existing home that functionality needs to mould with changing family requirements. Neither of us have resolute aesthetic preferences for the external look of the house, but simple, clean lines and privacy are a priority. Working to passive house principles of minimal footprint and minimal surface area makes sense to us. Our boys love being outside, so we also want a space that can be used in the rain (we do live in Ireland after all) and are happy to actively discourage screen time. My sister found a really nice house in a magazine with a split pitch roof, and this helped cure my lifelong fixation with symmetry just in the nick of time.

Most of our requirements for the inside of the house are to do with functionality and storage. We're keen to have an open plan living area close to the playroom and garden —a space that will nurture inclusive family time. Storage is also high on our agenda in order to maintain order and keep clutter out of sight. Top of the list is a large boot room to manage coats, wellies, schoolbags etc. We also want a large pantry to facilitate minimal units in the kitchen, and a laundry chute into the utility room to deal with nonstop cycles of the washing machine. The only frivolous idea on our list is a curved staircase, to soften the boxy feel.

Apart from getting self-build advice from friends and friends of friends, through a work assignment, I was really fortunate to interview many clients of Cyril Mannion of Mannion Passive House Builders. Chatting to Cyril and various homeowners proved to be an invaluable source of impartial advice, and we learned lessons from these conversations which have shaped our decision-making through the design process.

We deliberated over including a solid fuel heat source a lot, as we do enjoy a cosy stove in winter. But our mind was made up following a visit to a local low energy build. At the design stage the owner had similar feelings about a solid fuel heat source and included two sealed chimneys, just in case. But after two winters in the house, he was confident the chimneys would never be used. Due to the ambient temperature in the house, lighting a stove would simply produce unbearable heat.

The architect's initial concept for our house was a part two-storey, part single-storey 280 square metre home with integrated garage and car port to the front. We were delighted with the design and despite the fact that it was 30 square metres larger than the cap on our initial brief, we decided to proceed to planning with it.

But we discovered it to be true that on this type of a project, every step takes twice as long and costs twice as much as expected! And rather than the three months we expected, our planning application took seven months to prepare.

Brexit & the Deregulation Act:

what now for low energy building policy?

Last year, the government removed power from English councils to set their own energy efficiency standards for buildings, while the Brexit vote casts doubt over the UK's transposition of the nearly zero energy building targets. But the prospect of ambitious low energy building policy may be surprisingly strong. In the first article in our new Dispatches section – where we'll attempt to probe and investigate the burning sustainable building issues – Passive House Plus investigates.

Words: David W Smith
Additional reporting by Jeff Colley & Lenny Antonelli

The Conservative/Lib Dem government appeared to contradict its promise to support 'localism' when it removed the independent powers that allowed English local authorities to set energy-efficiency targets for new buildings. The 2015 Deregulation Act prevented English councils from using their planning powers to demand higher energy efficiency standards than building regulations with regards to energy efficiency, powers which arose under the so called Merton Rule.

The government's controversial move coincided with their decision to scrap a plan to make all English homes zero carbon from 2016, effectively leaving the country with no real ambition on energy efficiency in buildings. "It puzzles me to death that the government had a huge campaign in favour of localism, and passed the Localism Act to give authorities more power over their communities, then a couple of years later took away a lot of these powers," says energy efficiency consultant Dr Neil Cutland.

The step was a reversal of the general direction of travel since 2003 when Merton Borough Council introduced a rule requiring new developments to generate at least 10% of energy from on-site renewables. It was the first time a local authority had introduced a prescriptive planning policy and it proved influential. The Mayor of London and many other local councils followed suit and in 2008, the Planning and Energy Act enabled all councils in England and Wales to adopt the 'Merton Rule' if they wanted to. Merton Council even worked with many other authorities to help them to understand their rule.

"The 2008 Act had three relevant provisions," says Cutland. "The first two allowed authorities to set 'reasonable' targets for renewables and low carbon. But the third clause was the most important – it allowed authorities to set energy efficiency standards beyond building regulations. That could mean fabric standards, or overall energy performance standards. The developer was free to achieve the 10% reduction in whatever way he wanted, including through renewables. In effect, we didn't need all three clauses – just the last one."

The measures stimulated engineers and builders to design more energy-efficient buildings, but some developers protested loudly that on-site renewable energy technology increased costs and "prevented them from standardising their patent books," says Cutland.

They found an ally in Chancellor George Osborne, who was keen to avoid anything that might be seen to put the brakes on house building. "He bought the developers' argument that standards higher than existing house building regulations were a major obstacle to faster development. Believing construction was the key to unlocking economic prosperity, Osborne was keen to give housebuilders an easier ride," says Cutland.

The Deregulation Act of 2015 removed the autonomous powers granted to English local authorities in the 2008 Planning and Energy Act, though the same powers granted to Welsh local authorities were unaffected. "The Deregulation Act was a large bit of legislation mainly designed to get rid of archaic regulations, such as you can't sell pomegranates at an English market on Mondays. It sensibly swept the law books clean of unnecessary stuff but in the process chucked away a lot of good stuff," says Cutland.

(above) Former communities secretary Eric Pickles, who led the Housing Standards Review that led to the decision to remove powers for English councils to set higher energy standards than Part L; (below) a diagram of the much maligned and now abandoned Zero Carbon Homes standard, which is being resuscitated in London

A written ministerial statement about the Deregulation Act of 2015, explained: "Local planning authorities.. should not set in their emerging Local Plans, neighbourhood plans, or supplementary planning documents, any additional local technical standards or requirements relating to the construction, internal layout or performance of new dwellings. This includes any policy requiring any level of the Code for Sustainable Homes to be achieved by new development; the government has now withdrawn the code, aside from the management of legacy cases."

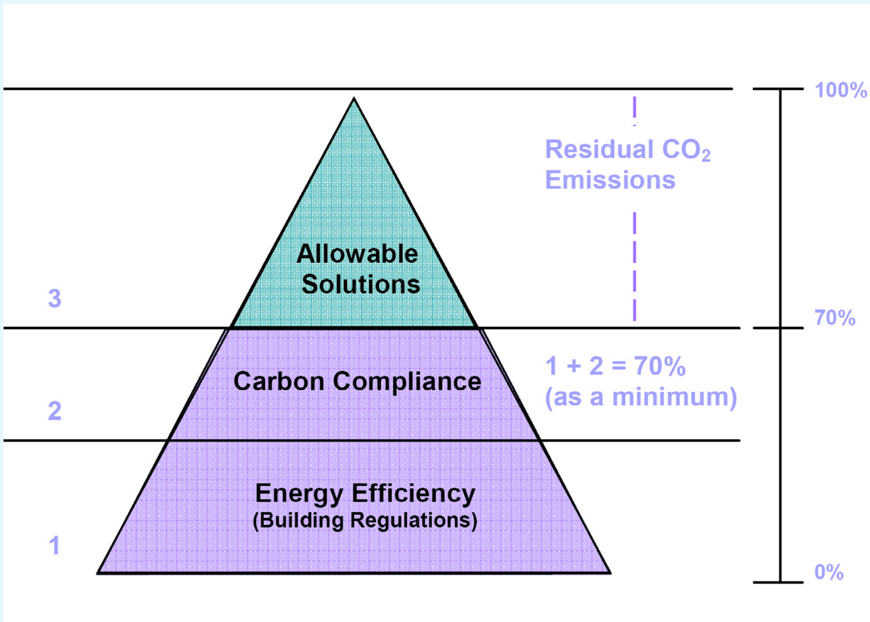
The government's regressive step had drastic consequences for the development of energy efficient housing in England, according to Cutland. Many local authorities had set ambitious targets and were disappointed to lose the powers. "A lot of the policies came from the elected councillors who were asking the local authority officers to implement them. They wanted to be at the leading edge of sustainability and to stand out," said Dr Cutland. "It was even more disappointing as it came at the time the government abandoned its zero carbon commitments despite forcing developers like Barratt's to spend 10 years investing millions in learning how to build low energy homes."

The new government buzzword became 'cost optimal' in an apparent subversion of an EU requirement to update building regulations to cost-optimal energy performance levels as a stepping stone to the EU's nearly zero energy building requirements. It was considered that the benefits of going beyond existing building regulations were not commensurate with the costs. "I, and many others, did not think the calculation method for 'cost optimal' was correct," said Cutland. "It should include the benefit to the householder. If a superior build adds £100 onto the cost of a house, but saves the householder £200 a year for 60 years, then it's a no-brainer. The government convinced the courts their methodology was correct, but there's another review of cost optimality next year and a lot of people are making a fuss about how it's worked out."

Although the Deregulation Act removed the ability of English local authorities to set energy efficiency standards for new buildings, it left in place powers to demand on-site renewable energy generation. Originally, the Deregulation Act would have removed these powers, but more than 50 companies lobbied the communities secretary Eric Pickles about retaining the so-called Merton Rule and an amendment was introduced to the Bill.

"Most authorities have accepted the situation and are just getting on with it, but it means developers can get away with building pretty ordinary houses and then slap solar panels on them to meet their obligations," said Cutland. "But this is not a long-term, sustainable solution. Panels drop off, get broken, and need replacing. The inverters have to be changed every ten years and the panels around every 25 years. It costs thousands of pounds and who says the owners are willing to do it? Under the old regulations, authorities could insist that the house was built passively to save energy. If it's better insulated and the build quality is superior, you never need to worry about it again."

Not for the first time, London has gone its own way. The Greater London Authority (GLA) is pursuing the zero carbon policies abandoned by central government. It has set a 100% CO_2 reduction target for new residential



development, to be met from a combination of on-site carbon reduction measures (at least 35%) and by funding local authority carbon saving projects.

"Just because [the GLA] are big and powerful they can argue that it's viable economically," says Cutland. "The price of the build in London is only a small proportion of the cost, they argue."

London's decision originated in ex-mayor Boris Johnson's refusal to accept the change of mind over zero carbon targets, leading to a special dispensation for the GLA to ignore the ministerial rules. "Lots of other councils are wondering whether they could challenge it as well, but they are terrified of legal battles. London is rather less afraid of that – they just tell developers that 'if you want to build in our patch, you follow our rules'."

London has aligned itself with the forward-thinking policies in Ireland, where there has been a move towards devolving the power to local authorities to insist on passive housing, with Dún Laoghaire-Rathdown County Council mandating the passive house standard or equivalent approaches for new buildings. This could lead to the construction of more than 20,000 passive houses in the county by 2022.

Campaigners who want to see English local authorities take a similar route to their Irish counterparts argue that the decision to rescind the powers in the Planning and Energy Act has no legal validity. They point to a ministerial statement which said the Government would not enforce the change until the Zero Carbon building regulations were in place. Of course, this never happened. "There's been no utterance from the Government, but if too many people pushed the boundaries of what authorities can do because of a potential loophole, they'd simply produce another ministerial statement closing the loophole," said Cutland.

However, the picture may not be as bleak as it seems. As we've seen, the changes in the Deregulation Act only related to the ability of English local authorities to set higher energy performance standards in planning requirements for housing. No such restrictions were placed on non-residential buildings, meaning local authorities are free to set ambitious energy performance requirements for commercial, educational and healthcare buildings, among others – including building types where monitoring of exemplar passive house projects have proven highly successful.

And aside from the GLA's exemption and plans to enforce zero carbon targets in an area of the UK that's bound to continue to see substantial amounts of construction activity, the act's requirements do not apply to the Planning and Energy Act as it applies in Wales, meaning Welsh councils are free to set ambitious energy performance requirements.

Other local authorities have taken it upon themselves to promote low energy buildings in other ways: Exeter City Council now mandates the passive house standard for all its own build projects, while Norwich City Council recently launched a £300m fabric first framework to support the construction framework, open to all local authorities and housing associations, to support the construction of passive house and low energy building.

Similarly, as Neil Cutland points out, the Climate Change Act (Scotland) 2009 actually made it mandatory for planning authorities to implement a Merton rule.

Section 72 of the act states as follows:

A planning authority, in any local development plan prepared by them, must include policies requiring all developments in the local development plan area to be designed so as to ensure that all new buildings avoid a specified and rising proportion of the projected greenhouse gas emissions from their use, calculated on the basis of the approved design and plans for the specific development, through the installation and operation of low and zero carbon generating technologies."

The act doesn't define low and zero carbon generating technologies, though this has been unsurprisingly interpreted by local authorities to mean renewable energy technologies rather than demand reduction measures, although some development plans have touched on this. The Aberdeen Local Development Plan, for instance, states that "All new buildings are required to produce ever-lower proportions of greenhouse gases through their siting, layout and design."

The Outer Hebrides Local Development Plan goes further, offering an exemption to the Section 72 requirements for buildings built to the passive house standard, setting a potentially significant precedent.

A 2013 update to the Sullivan Report 'A Low Carbon Building Standards Strategy for Scotland', a report of a panel appointed by Scottish ministers, included recommendations to investigate whether proposed 60 to 75% carbon emissions reductions targets for new buildings would satisfy the nearly zero energy building (NZEB) targets of the recast EU directive on the energy performance of buildings, and if not, to align energy standards for new buildings to NZEB levels by 2019.

Indeed, if the Scottish National Party, and Scotland more broadly, is serious about remaining in — or rejoining — the European Union if it won independence from a post Brexit-UK, it might be advised to go ahead and incorporate NZEB standards into its own laws now anyway. After all, it is stated EU policy that "Once an applicant country meets the conditions for membership, it must implement EU rules and regulations in all areas." Taking the initiative to voluntarily and fully implement a key EU policy to deliver on the shared European and international obligations regarding climate change mitigation is exactly the kind of initiative a prospective member may wish to take to increase its chances of a favourable response.

Similarly there's also an argument that Westminster would strengthen its bargaining position in the Brexit negotiations by going ahead and adopting European laws, such as NZEB, that deliver on shared international obligations, while also being self-evidently sensible measures to benefit building owners and tenants, while increasing national energy security.

But regardless, in spite of the uncertainty on low energy building policy arising from the Brexit vote along with last year's Deregulation Act and the powers it removed from councils in England, there is still plenty that progressive public authorities across the United Kingdom can do — and in the cases of Exeter and Norwich City Councils, are doing — to promote passive house and fabric-first low energy building.

While at first glance the opportunity for progressive low energy building policy may appear substantially diminished, deeper analysis indicates that may be far from the truth. As the London plans on zero carbon homes indicates, progressive policy can emerge from adversity – and may even become more likely as a means for progressive authorities to challenge retrograde national policy. When all is considered, it may be the case that the only new build sector in Britain that is left entirely at the discretion of national government is private sector housing in England – and excluding the Greater London Area at that. Notwithstanding the possibility of the UK government deciding to deliver low energy building requirements in line with their European neighbours, the opportunity exists for the governments of Scotland, Wales, and local authorities the length and breadth of Britain to procure, promote, incentivise or mandate the construction of low energy buildings.

(below) Exeter City Council's housing development manager Emma Osmundsen, who has helped the council to pioneer a passive house policy based on successful projects such as the Knights Place sheltered housing scheme, where a post occupancy evaluation study found that in nine of the 18 units the space heating system hadn't been turned on in the four years since the residents moved in.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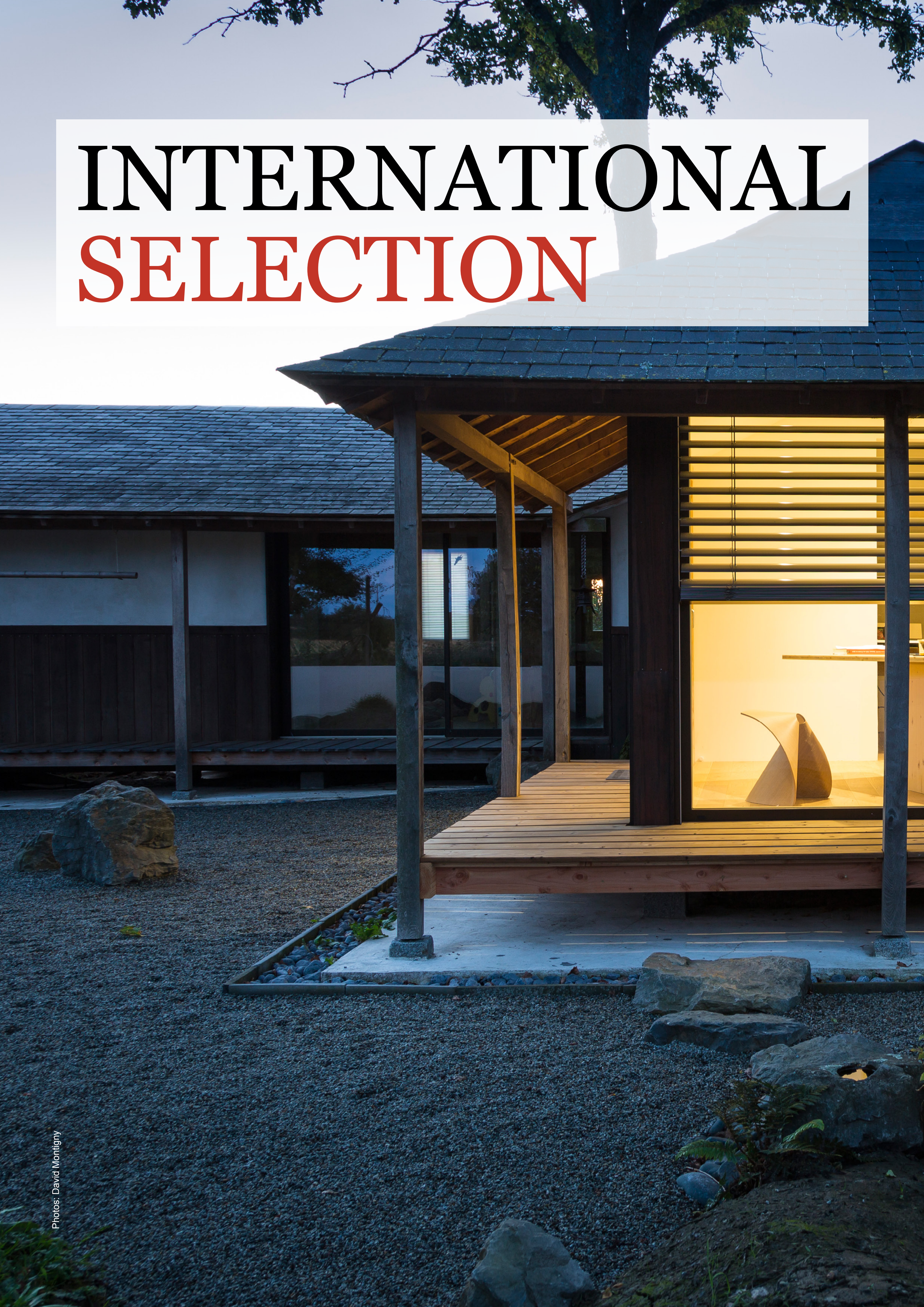


Photos: David Montigny

Mizu Project, Ille-et-Vilaine, Brittany, France

This tiny office, dubbed ‘Mizu Project’, is the smallest certified passive house of any kind in the world at just 12 square metres. It was designed and built by engineer and passive house consultant Thomas Primault, who runs his consultancy Hinoki from the building near the city of Rennes in north-west France.

“The architecture is a tribute to Japanese tea houses, and the principles of minimalism, simplicity and naturality,” he says of the building (Mizu means water in Japanese). Primault built the structure out of his need for a space in which to work comfortably, and meet his clients. Keen to both live and work in the countryside, he built the office right up against his own home amid the fields and woods of rural Brittany.

But building a passive house this small posed challenges — its tiny volume meant it had a relatively large surface area from which heat could escape, and from which air could leak. This made achieving the heat demand and airtightness targets of the passive house standard tough.

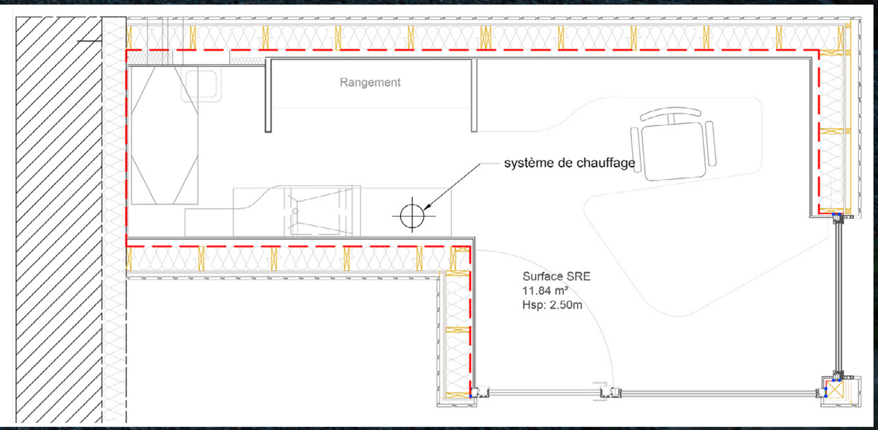
Ultimately, he built the structure from a lightweight timber frame of local wood, insulated with cellulose and Pavatex Pavaflex wood fibre – with Pavatex Isolair sarking boards – and for the floors he used Porextherm Vacuspeed vacuum insulated panels, which offer excellent insulation for low thickness, thus allowing more head space inside. Windows and doors are thermally broken triple-glazed timber-alu clad systems, with Unilux Design Line window and entrance door on the patio-facing south façade and an Internorm Varion window on the east façade. He also lifted the entire lightweight building off the ground to cut thermal bridging, and wrapped the whole interior of the structure in Pro Clima airtightness membranes.

But the airtightness test also posed a challenge — no blower door machine small enough to test the building properly was available. So instead, Primault used a machine normally employed to test air leakage from ventilation ducts (and the building scored 0.4 air changes per hour).

And while at first he wanted to heat the office only with his kettle, he did find the office a little cool on winter mornings, so ultimately installed a heating diffuser on one of the Helios heat recovery ventilation system’s intake ducts.

One interesting innovation: the interior walls are plastered in Enerciel phase change material to offer something approximating thermal mass.

Primault reckons the whole project cost in the region of €25,000. ►



Photos: Simon Devitt

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings and stunning photos we had to omit from the magazine.

The digital magazine is available to subscribers on www.passive.ie

George House, Wanaka, South Island, New Zealand

Designed by architect Rafe Maclean, George House is the first certified passive house on New Zealand's South Island (there are seven more on the North Island). Maclean's clients had heard about passive house while watching an episode of Grand Designs, and got hooked on the idea. So they knocked the existing 1950s house on the site in the resort town of Wanaka, and appointed Maclean to design this elegant new passive house.

It was Maclean's first passive house, and he admits it was a "steep learning curve". The new 141 square metre home was built with structural insulated panels added to an insulated timber stud, and scored an airtightness test result of 0.57 air changes per hour. Ventilation is provided by a Zehnder Comfoair MVHR system, with triple-glazed Schweikart windows. Its roof also boasts a solar PV array, which helps to power the electric panel heaters inside.

Completed in June 2015 and certified by Ireland's globetrotting Passive House Academy, the house experienced outdoor temperatures of -10C outside during its first winter, but maintained a comfortable 20-22C inside. "The clients are super happy with the result, the design and the building performance," says Maclean.

Last year over 200 people came to visit the house over a three hour period during November's international passive house open day. "Which played havoc with internal heat gains," Maclean says.

He adds that the homeowners are still happy to show anybody around the house, as they are "keen on spreading the message that this is the way to build".

And despite the challenges of the build, Maclean and his builder Issac Davidson have become a certified passive house designer and tradesperson respectively since the house was finished, while the house also picked up the southern architecture award at 2016's New Zealand Architecture Awards.

UK's largest passive building

opens to 2,400 students and staff

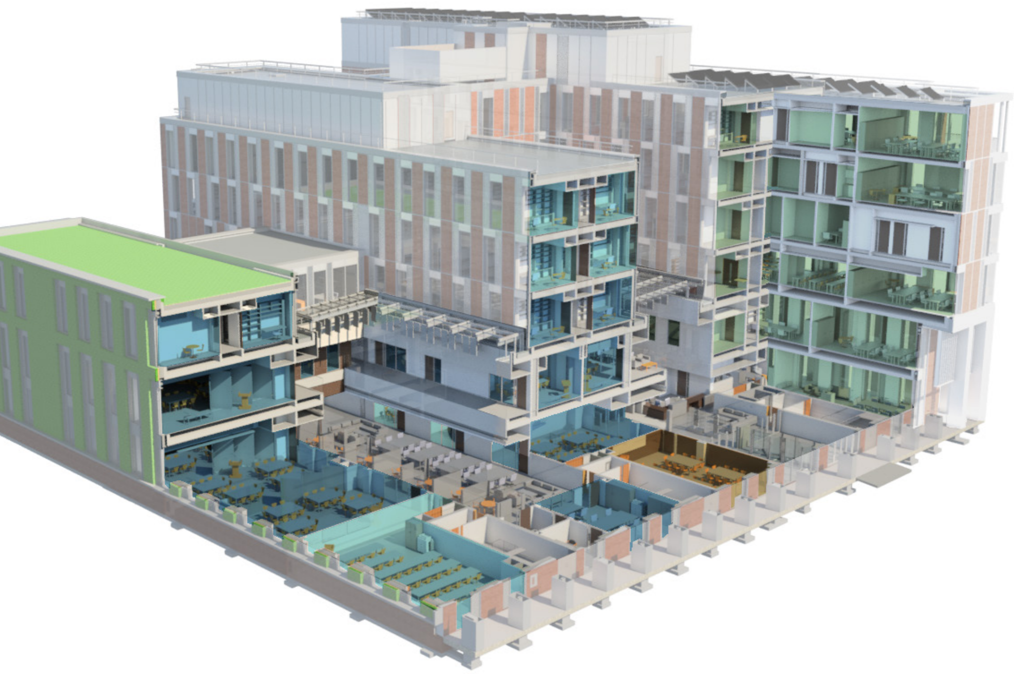
Completed early this year, the new Centre for Medicine at the University of Leicester is by far the largest single building in the UK to meet the passive house standard — and not surprisingly, its design and construction posed tough new challenges for how to meet the rigorous low energy standard on such a large, complicated building.

Words: Kate de Selincourt

Photos: Martine Hamilton Knight (external), University of Leicester/Tim Cornbill (internal)

"You can make a building more simple to build without it being a box."

(above) The Passive House Institute certified PR60energysave triple-glazed glass roof, as supplied by DVS Ltd; (below) cut-away computer-generated model showing the building's structure and interior



The Centre for Medicine at the University of Leicester represents a landmark for passive house in the UK. It is by far the largest single building to achieve passive house certification – around four times larger than its UK predecessors – and one of the first UK passive house buildings to engage with the world of mainstream commercial construction.

The Centre for Medicine brings together three academic departments at the university, previously housed in 19 separate buildings, and accommodates 2,400 people in a mixture of teaching, social, research and office accommodation.

As architect Jonathan Chadwick of Associated Architects explains, originally the University of Leicester wanted a 'zero carbon' building to act as the centre piece of their carbon reduction plan. However the architects and M+E engineers Couch Perry Wilkes together explained that zero carbon was a nebulous term and a carbon neutral building isn't necessarily efficient and cheap to run. "Instead we advised the university that passive house should be the basis of the project as it has a proven track record for delivering comfortable, low energy buildings", Chadwick said.

James Elliment from lead contractor Willmott Dixon believes this project exemplifies passive house's next big challenge in the UK: the transition between small, mainly domestic buildings and large commercial projects. "There is a huge difference in the way you construct large commercial buildings — the way you build, the supply chain, design and procurement." Designers with experience of small-scale passive house may be less familiar with these mainstream, larger-scale systems. Meanwhile, mainstream contractors tend not to be familiar with the demands of passive house.

All these challenges came into play with the Centre for Medicine – and all were successfully overcome, and the building has now been certified passive.

But the building is far from the compact form that gives the best fabric efficiency. A two-storey block containing lecture rooms and communal facilities is surmounted by three slab-shaped 'towers' of different heights, up to six storeys altogether.

The relatively 'non-compact' form was driven by the brief, Jonathan Chadwick explains: "One of the key client requirements was that all of the departments being brought into the building should have equality of accommodation, so all of the offices are the same regardless of where they are in the building – this included those

facing north: not great for heat loss obviously, but the University of Leicester were keen that the building would stand on its merits when judged against other criteria than energy use."

A building this big makes distinct demands of the construction team, both because of the physical scale and weight, and because of process and oversight. An approach that works well for a small scale passive house project might not work so well at scale. "For example, insulated blockwork with parge for airtightness works fine on a small build, but it doesn't really upscale to large buildings," James Elliment argues.

The Centre for Medicine was procured on a design and build basis, so the construction approach was chosen by the contractor. The frame is of post-tensioned concrete, but rather than the architects' original proposal of precast concrete panels, for the upper façade Willmott Dixon opted for high performance curtain walling, because it is light, reducing the size of the foundations required, and it tends to be relatively fast to put up.

However, while curtain walling is a well-established approach in the commercial sector, passive house levels of performance are not so well-established there.

"The standard systems don't always offer the performance needed, so we specified a high-performance curtain walling system from Schuco, who are the 'Rolls Royce' of suppliers," James Elliment says. Other aspects of the design, such as the shape with its relatively high surface area put extra demands on the thermal and airtightness performance of the walls. Additional insulation was needed, which in turn led to the need to fit a vapour control layer. As a result, the curtain wall turned out to be pretty labour-intensive to complete.

Airtightness too had to be exceptionally high. Because of the increased fabric performance needed, in this building the team had to achieve an overall air change rate of 0.33 air changes per hour at 50 Pascals — a great deal tougher than the passive house minimum standard of 0.6. And airtightness is inevitably a challenge with curtain walling: "The system is basically hollow sticks of aluminium secured by lots of connectors, creating openings to be filled either with cladding or glazing. This involves lots of components, lots of seals and gaskets," Elliment says.

Unsurprisingly this has the potential to lead to myriad tiny air leaks. "We really had to push it to get to the required airtightness level, it's at the limit of what a curtain walling system can achieve."

Glazing

Despite the performance disadvantages of floor-to-ceiling glazing in passive house, the offices nonetheless have full height windows. "From a purely passive house point of view the reasons probably aren't very compelling!" admits Jonathan Chadwick. However, there are always other factors at play: "They add something to the character of the exterior and to the feeling of a room."

The architects do recognise that you can have too much of a good thing, so added ceramic fritting (a kind of hard paint fused to the glass) at low level (below desk height), to provide privacy and reduce solar gains.

To limit unwanted solar gain, there are moveable solar blinds on most windows. These are under the somewhat space-age sounding control of the BMS: "The blinds are controlled via an astronomical timeclock to track the solar path and linked to internal temperature monitoring," Lee Davies of M&E engineers Couch Perry Wilkes explains, adding that users can manually override the controls, for example if they want to reduce glare.

Services

Like many other university campuses, Leicester has a district heating system, which powers the Centre for Medicine's space heating via a mix of underfloor heating, and individually controlled radiators in the office spaces.

However, continuing to circulate heat outside the heating season, simply to supply hot water, can pose overheating risks. When, as here, hot water demand is low, a communal heat supply can also be very wasteful. For this reason Couch Perry Wilkes specified electric point-of-use heaters and water boilers for hot water. As Lee Davies explains: "This meant we could avoid the considerable heat losses you would get from long lengths of pipework throughout the building, minimising losses to ensure maximum efficiency."

A big building obviously needs a big ventilation system, and as Couch Perry Wilkes explains, the contractor couldn't locate anything that was officially passive house certified for the size and performance required. Instead bespoke air handling units (AHUs) were manufactured. Featuring a high-efficiency thermal wheel for heat recovery, these units were rigorously tested by BSRIA for thermal conductivity, air leakage and cold bridging.

Although the engineers report that it is not unusual with equipment of this size to need to commission bespoke units, there is an extra catch with passive house. Because the AHUs were not passive house certified an automatic efficiency penalty was applied, which the building had to 'make up' in other ways: "The AHU efficiency penalty was [another] reason more insulation was required, to improve

U-values to compensate," Davies explained.

Preventing overheating

In a small domestic building, the provisions in PHPP to calculate the overheating risk often represent an improvement on the hit-and-miss attention paid to the issue in this sector.

However in the mainstream commercial sector, with its high occupant densities, large amounts of powered equipment, and often, extensive glazing, analysis tends to be more sophisticated, and at the Centre for Medicine engineers Couch Perry Wilkes carried out dynamic simulation modelling. What's more, PHPP shows 0% overheating for this building, says CPW's Stephen Ball.

The Centre for Medicine does not have quite the extent of south glazing that besets some buildings, however high internal gains are anticipated from the 2400 occupants, and their equipment (including some distinctly old-school cathode-ray computer monitors that are on twenty-four-seven as part of a long-running research experiment).

Summer cooling is provided via manually operated vents in all spaces that are secure to the outside, plus automatic roof light openings in each of the building's two Lamilux PR60 Energysave Passive House Institute certified glazed roof systems to discharge excess heat.

Two further strategies for cooling were included. There is provision for active cooling via the circulation of chilled water though the concrete frame. And on top of both these strategies, there is also a ground to air heat exchange system — an extensive set of pipes buried under the building, designed to pre-cool incoming air in the summer. This system can also pre-warm air in winter, when ground temperatures are higher than outside air temperatures.

The ground air heat exchange labyrinth was not easy to install, because, with the site being so tight, it had to fit right under the building, between the piles. Willmott Dixon's James Elliment recalls: "If you can imagine threading 1.6 km of pipe around the piles and pile caps and all the other underground services…. There was a lot of discussion about whether to install the ground tubes before the piling – risking it being squashed by the piling plant — or after.

"We did the latter but ended up having to expose the piles to fit the tubes – even though the piles work by friction." Because of the likelihood of condensation in the pipes during the summer, the whole system is carefully laid out with falls that drain to a sump, which is then pumped out. Microbial growth is mitigated by a silver lining to the tubes, and they will be regularly maintained.

Early calculations indicated that the system was expected to offer useful pre-conditioning around 40% of the time, explains Stewart Powell, engineer with the supplier Rehau — the rest of the time the advantage is marginal, and would not justify the additional fan power required to draw air through the system, so the BMS will switch the intake over to direct external air when this is the case.

Getting to know you

The design team are all signed up to a three year soft landings period. As Jonathan Chadwick explains, the design team is committed to work with the end-users and the estates team to fine-tune the building, and make sure that it's being used optimally

(clockwise from top left) excavation of the site for the installation of the reinforced ground-bearing concrete slab; composite panels clad with a brick finish, with a 300mm cavity inside that was later insulated with Knauf Earthwool; facade mock-up panels at the facade engineer Wintech's testing yard in Telford, built to test the buildability of the systems and iron out details like blind integration and airtightness; thermal bridge-free detailing, with masonry walls resting on thermal insulation; airtightness detailing with Pro Clima Intello vapour membranes; Rockwool mineral wool insulation batts fixed externally on the upper floors

from an energy and comfort point of view. The building and the users are learning about each other's behaviour, with a bit of adaptation on both sides.

The idea is that when this process is complete, the building will run pretty automatically at optimum performance. Most of the building's systems work under an integrated system of controls, responding to both the weather outside and to indoor conditions such as CO_2 levels and temperature. "This is key to effective building management and operation," believes Lee Davies.

Some of these systems — local temperature settings, natural ventilation, and the movement of the solar shading — can also be controlled by users, but in a building with 2400 occupants, it was impossible for the design team to explain the systems to every user face to face, so inevitably it has taken a while for the users to learn how the building works, which in turn means it takes longer to tune the controls.

For example the office vents are designed to allow fresh air to cool the building at night in readiness for the next day, but as architect Jonathan Chadwick reports, there were "a few teething issues over the heights of summer when a small number of occupants complained about overheating in their offices." The design team investigated the reasons for this as part of the soft landings process. Chadwick says: "It looks like a combination of factors — a series of very hot days, vent settings not being optimised, shading being overridden, openable vents not being used for night purging. Communicating this back to the staff is obviously a priority."

Debbie Oldham is departmental manager at the Centre for Medicine, so works in the building: "It has taken us a bit of time to get used to the automated systems," she says. "We are still learning to live in the building, there are a lot of different people to communicate with and explain things to."

"People did keep asking 'why can't I just turn the light on? We are learning to get used to the lights coming on when you come into the room and dimming when the room is light enough, or the exterior blinds coming up and down of their own accord."

While the engineers are proud of the way the automated systems have the potential to pare energy consumption down to the bone, it has been a learning process for the rest of the design team as well.

James Elliment of Willmott Dixon wonders if building automation could be overdone: "We know how we want the buildings to operate and how we want them used. We have given them a really intelligent building — we thought yes this is fantastic, but then you get an academic sitting there doing their research and things are going on and off by themselves, they find it annoying — which you can understand."

He concludes: "We have to learn from that, we have realised you can't take all the control away from the occupants."

The beauty of the soft landings process is that it is a process of mutual learning, Elliment adds. "These were not all things that we thought of beforehand, but this is what soft landings is for, we are tweaking and changing as we learn." And meanwhile, the users, with all their individual perspectives, are learning too.

As academics the users are naturally curious,

as Sarah Roberts, sustainable projects officer at the university, puts it: "They question everything!" The university staff and design team have now run several workshops for the users as part of the soft landings process. "We have done an awful lot of communication and it really did help."

What about next time?

The successful achievement of passive house certification at Leicester proves that this size of passive building is possible in the UK. How easy will it be to repeat?

The total project cost of £42M included the university's fit out and AV / IT installations, plus landscaping and other items. "When you strip these out and compare the construction cost alone then it seems very reasonable for the quality of the building," Jonathan Chadwick believes.

The brief required the building achieve a BREEAM Excellent rating too, which added costs. "It has some benefits but how much it adds is a bit of a contentious issue," Chadwick says. The extra-high fabric performance needed, and the construction of the ground air heat exchange system under the building, also added costs.

Quality control, so crucial to a passive house build, did pose challenges on such a big site. One of the satisfying aspects of a successful small passive house build is the way it can liberate the existing ability of site crew to deliver really high quality work. This tends to flow from a fully 'bought in' site culture — not so easy to achieve when you have a large crew with, inevitably, much higher turnover, points out James Elliment.

"A lot of passive house is to do with quality control on site. In a small house with a small team you have more say in the choice of skill sets employed on the site, and it is relatively easy to monitor quality. This control is diluted on a big building, you need a much bigger labour pool and the management of that becomes harder. As an industry we have to face this challenge."

With the curtain walling, for example, to get to the required airtightness level "you are really relying on workmanship". But this workmanship is carried out by site crew, up on scaffolding — much harder to police. One option for large-scale passive house construction might be to take more of the construction off-site. "I think if you can reduce the number of areas sensitive to site workmanship, you are in better control," Elliment believes.

"You can make a building more simple to build without it being a box. Certainly one of the great things about the Centre for Medicine is it is not a box, it's a lovely building, it's amazing architecturally."

The Centre for Medicine was the second large passive house building Willmott Dixon had undertaken. The first, the Chester Balmore flats for Camden Council in north London, had been by everyone's admission a pretty steep learning curve. Peter Warm, whose passive house consultancy Warm certified both, was impressed by the way Willmott Dixon took this learning forward. "I give the contractor full marks for putting in the effort from the start. Willmott Dixon did really well, handling the mismatches between what conventional engineering could give, and what passive house needed."

"What's great about this building is that it is integrating passive house into a large construction. Large scale passive house is pulling the large scale contractors into the requirements of passive house. You could see jobs like Leicester as stepping stones. But they made it, and have got a brilliant building."

According to the calculations by the engineers, the finished building is expected to use around six to seven times less energy than the medical school's previous accommodation, and monitoring will show if this is the case.

Despite any misgivings about the level of automation, Associated Architects have been delighted to discover how happy the users now are. "Overall the University's project manager said that he'd never had so few gripes and phone calls from end-users after a building had been handed over, so we think this is a real positive for passive house and soft landings," says Jonathan Chadwick.

"We're proud that the building achieved passive house certification, and we think of it as a milestone for our practice and for passive house in the UK."

Debbie Oldham is also delighted, saying: "I love the building, I feel really proud to be in it. The students like it too — at the moment the undergraduates are supposed to be out by 6.30, but they are requesting that we keep the building open later for them, as they want to stay!"

Perhaps the only way to get rid of them will be to build some passive house halls of residence for them as well.

Do design & build contracts work for passive house?

Although design and build has its fans, it's a procurement approach that generates its share of gripes in the passive house world. In design and build the main contractor takes on the building mid-way though the design process, so they do have more chance than in a conventional build to input into the design. However, problems can arise when the client employs designers to carry out a concept design to go to planning, and then invites contractors to price for completing the design and constructing the project. At this point many details are set in stone, and it may be too late for the contractor to optimise the basics of the design, but they are still responsible for meeting the passive house specification, and bearing the costs of any late changes needed to reach this.

Because designers and contractors are not working together from the off, the design team misses the invaluable input from builders to help make the designs buildable. Meanwhile, the designers may lose control of crucial aspects of the finished building, especially if they are not taken on by the contractor for the build phase.

James Elliment of Willmott Dixon says: "You usually end up with the contractor and their supply chain doing a lot of the detailed design, but with this contract arrangement, the lead time is really short, because you don't start procuring these designs until you've got the contract. For the Centre for Medicine we signed the contract, and four weeks later we were starting on site, and still procuring designs as we went along."

Jonathan Chadwick of Associated architects agrees that even though in the end it worked out fine here, the arrangement was not ideal. "If we did it again we'd ensure that design development periods were sufficient, and specialist subcontractors appointed early enough."

James Elliment says he is not against two-stage or 'negotiated' design and build contractors for passive house, as these allows the contractor to influence the design, but is not in favour of one-stage tenders, which preclude the contractor from doing so.

"I am completely converted to passive house but I am concerned that the industry won't take it up if contracts aren't let the right way. If contractors are left with a lot of the risk then they will be nervous, and their perceived premium will increase. This won't be good for passive house."

Elliment favours instead a collaborative framework approach, with open cost planning. "You can design it together, so the whole thing can be well thought through, and everyone has some comfort about costs and risk."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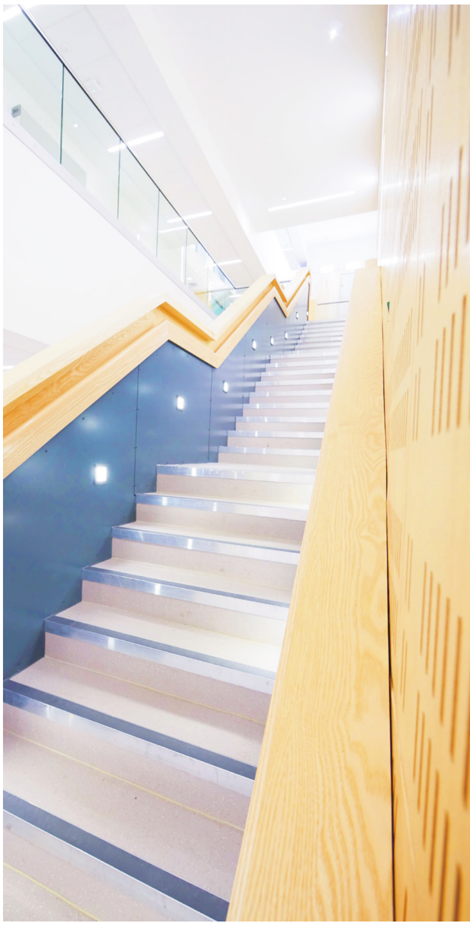
SELECTED PROJECT DETAILS
Architects: Associated Architects
Main contractor: Willmott Dixon
Project management: Bidwells
M&E engineering: Couch Perry Wilkes Partnership
Civil & structural engineering: Ramboll
M&E contractor: NG Bailey
Passive house certification: WARM
Ground air heat exchanger: Rehau
Cost consultants: Gleeds Worldwide
Landscape design: Gillespies
CDM co-ordinator: Ridge
Approved inspectors: Approved Design
Planning consultant: RPS
Breeam assessor: HRS
Curtain walling (contractor): Advanced Glass Facades
Curtain walling (supplier): Schuco
Glazed roofs: DVS
Green wall: ANS Global
Composite cladding: Skygreen / Kingspan Benchmark
Glass balustrades & fixed solar shading: Scala Vetro Partitions
Ceilings (suspended): Global Contract Interiors
Plasterboard ceilings & partitions: Reynolds
Acoustician: Cole Jarman
Roofing: Briggs Amasco
Insulated render: Intastruct
Tiling: WB Simpson
Brickwork: Ibstock
External insulated render: Marmorit
Solar PV: GMI Energy



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"A lot of passive house is to do with quality control on site. In a small house with a small team you have more say in the choice of skill sets employed on the site, and it is relatively easy to monitor quality. This control is diluted on a big building."

PROJECT OVERVIEW

Building type: 12,800sqm (gross internal floor area) 2-6 storey detached concrete framed teaching and research facility for the College of Medicine at University of Leicester.

Location:
University of Leicester, Leicestershire, UK

Completion date: January 2016

Budget: Construction cost approx £29M, total project cost including VAT, FF&E, AV/IT, fees and landscaping approx £42M

Passive house certification: Certified

Space heating demand (PHPP):
15 kWh/m^2/yr

Heat load (PHPP): 11 W/m^2

Primary energy demand (PHPP):
116 kWh/m^2/yr

Environmental assessment method:
BREEAM – Excellent rating

Airtightness (at 50 Pascals): 0.33 ACH

Energy performance certificate (EPC):
A:19

Thermal bridging: Thermal bridges for capping support brackets, balustrade support brackets and curtain walling support brackets were modelled and quantified, pile caps insulated on all sides, thermal breaks to all steelwork connections, low conductivity TeploTies to cavity masonry, Foamglas loadbearing insulation to base of masonry.

Ground floor (typical construction): 22mm terrazzo tiles on decoupling mat, on 70mm floating screed, on 30mm Knauf Polyfoam Floorboard Eco Extra insulation, 150mm ground bearing RC concrete slab on 65mm Knauf Polyfoam C350SE insulation. Average ground floor U-value 0.250 W/m^{2}K

Walls: Various constructions – average U-value 0.130 W/m^{2}K

Lower floors typically: 103mm Ibstock Cheddar Red brickwork externally, followed inside by 300mm cavity with Knauf Earthwool Dritherm 32 Ultimate mineral wool insulation, 140mm medium density blockwork, 13mm wet plaster internally.

Green wall: Green wall planting modules externally on treated timber battens, followed inside by breather membrane, 100mm medium density blockwork, 300mm cavity with Knauf Earthwool Dritherm 32 Ultimate mineral wool insulation, 140mm medium density blockwork, 13mm wet plaster.

Upper floors typically: PH certified thermally broken Schuco curtain walling system with brick slips externally, followed inside by carrier boards fixed to insulated spandrel panels, 25mm air cavity, 100mm Rockwool Duoslab mineral wool insulation, 150mm Rockwool Duoslab mineral wool insulation, vapour control layer, IWL plasterboard studs with two 15mm plasterboard layers, and skim finish.

Roof, typical construction: Paving slabs on spacers / pebble ballast, on separation layer, on 270 / 410mm Jablite Premium Flat Roof Inverted insulation, on hot melt roof waterproofing, on 250mm RC concrete slab. Average roof U-value 0.130 W/m^{2}K

Glazing: Schuco PH certified triple-glazed curtain walling with argon filling and an overall U-value of 0.75 W/m^{2}K (average)

Passive House Institute certified Lamilux PR60energysave triple-glazed glass roofs to east and west atria. Overall U-value 0.82 W/m^{2}K

Heating system: Connection to University of Leicester CHP district heating system for space heating. Electric point-of-use heaters and water boilers for hot water.

Ventilation: Bespoke Barkell air handling units with heat recovery, tested by BSRIA at 74% efficiency

Electricity:
115 square metre 30kW solar PV array

Green materials: Post-tensioned concrete frame to reduce the total volume of concrete, TABS embedded soffit cooling within concrete structure, Rehau ground-air heat exchange with 1.6km long pipework labyrinth buried beneath the building, green / brown roof and living wall to increase site biodiversity, Schuco CTB external shading blinds.

YORKSHIRE PASSIVE HOUSE
pushes cavity wall boundaries

Green Building Store continues to fine tune passive house design and construction techniques with exacting attention to detail, as demonstrated by its latest super-insulated, stone-clad cavity wall house in West Yorkshire.

Words: David W Smith

When Angie and Paul Dallas came to buy windows from Green Building Store in Huddersfield, they thought they were nearing the end of a long journey. It had taken five years of battling with local councillors and conservationists, and two redesigns from different architects, to get permission to build a house in the garden of their property in the West Yorkshire village of Golcar. After finally gaining approval for the design, all they wanted were low energy, high-performance windows to reduce heating costs. But the visit to the Green Building Store turned out to be just the beginning of a new adventure.

Company director Chris Herring looked at the architect's drawings and suggested going much further with their green agenda to create a passive house. "It was very unusual that we could do that using the original plans. The vast majority of designs would have had the wrong form, or pointed in the wrong way for a passive house," said co-director Bill Butcher. "But the Golcar design was a simple rectangle and all we needed to do was to re-orientate it towards the south and take some windows out of the north side."

Green Building Store have been pioneers in the development of passive houses in the UK. In the nearby village of Denby Dale, they designed the first UK passive house to be built with cavity wall construction. It served as a template for their work on the 296 square metre, three-storey, four-bedroom Golcar passive house, although there were some significant modifications and improvements on the system used at Denby Dale.

Angie and Paul Dallas were excited by the idea of building a passive house. Angie, an optometrist by trade, has a love of new engineering and had "visited every house building show in the UK" searching for innovative ideas. She was already familiar with the passive house concept. "I'm delighted we changed our minds and went for a passive house. You don't get hot spots, the house is not at all fusty-smelling and it has been at a lovely constant temperature since we moved in last May," she said.

"It has many qualities that other houses don't have, including a peace I've not experienced elsewhere. I think it's down to the insulation and the quality of the windows, which make it very quiet. Someone joked that in the event of a nuclear war they'd come round to our house."

"We could have used less insulation in the walls and saved money. With more experience of building passive houses we can fine tune it better."

Photos: Iain Richardson

When Angie and Paul decided to build a new house, they retained four fifths of the original plot, including a significant amount of land. But they sold their original house to finance the project. To make the old house saleable, it was necessary to construct retaining walls on both sides of the new house and another one to provide parking spaces, which made the project more costly than planned.

The Golcar passive house is a radically different place from the 1930s detached house the couple previously inhabited. It has an open plan kitchen and living space on the middle floor with views over the garden and the beautiful Colne Valley. The main bedrooms are down on the ground floor with access to the garden. The third floor is within a warm roof space and comprises a study, spare bedroom and the plant room for the MVHR.

Paul loves his new home, not least because he helped to build it. An engineer by trade, he ended up working full time on the project and being compensated for his hours. “Paul wanted to project manage from the start and when they turned up on the first day with a foreman, his nose was put out of joint. But he kept working and when one member of the team left, they never replaced him,” said Angie.

Bill Butcher said his team took care of all the passive house elements, but Paul was responsible for the second fix. “Paul took over what I call the ‘pretty side’ of the build. Green Building Store looked after the building fabric, airtightness, heating and MVHR systems. Then Paul did all non-passive house aspects, including kitchens, bathrooms, staircases and fittings.”

The Golcar passive house has a similar cavity wall design to its Denby Dale forerunner. This style is in keeping with the local vernacular in West Yorkshire, where there is a tradition of heavy masonry. Both houses were built with the same Yorkshire stone externally, although the Golcar one mixed stone with timber cladding on certain aspects. “The Golcar house was an evolution of the Denby Dale project. We learned a lot of lessons and did things in a slightly more sophisticated way,” said Butcher.

One of these was using extruded rather than expanded polystyrene in the 300mm super-wide wall cavity, below the damp proof course. “Examining the evidence from both sides of the argument we feel extruded is more moisture resistant than expanded and thus retains a better lambda value [thermal performance],” said Butcher. “However the industry is still arguing.” The DPM was also taken through the inner leaf to keep the first concrete block below the floor slab dry, allowing optimal thermal performance.

Another one of the main differences between Golcar and Denby Dale was the use of a new range of high-performance windows from the Czech Republic. Originally, the intention was to use windows from the Green Building Store’s Ultra range, but they later switched to the new Progression range. The windows offered an even better U-value, as well as narrow sightlines and a virtually invisible frame viewed from the outside, which increased passive solar gain.

Another striking difference with the Denby Dale project was the use of a ‘warm’ cathedral roof as opposed to a cold one.

Though a more expensive option because it involved a more complex build, the warm roof created extra space in the attic area. The walls were also thicker on the Golcar house. “The structural engineer specified that we use 140mm inner concrete block leaf due to the large expanse of walls. In theory we have even more thermal mass than at Denby Dale, although in reality this will probably make little difference,” said Butcher.

The Golcar heating system also involved trying out a different approach. At Denby Dale, there had been issues with the boiler ‘cycling’ and turning on and off too frequently. So at Golcar, the team decided to totally separate the function of the MVHR system and the heating system. The Vaillant EcoTec central heating boiler and MVHR unit are both located in the upstairs plant room but work independently. The designers used a thermal store in the plant room to add volume to the system. “Without the buffer tank, it would be too small as there are only two small radiators and three towel radiators in the whole building,” said Butcher.

The thermal store is heated by solar thermal panels too, and also supplies hot water. The boiler heats the thermal store to a certain temperature, and the store only loses its heat slowly. If the room temperature thermostats drop, the radiators and towel rails in the system take water from the thermal store. The boiler is only asked to switch on when the thermal store itself has dropped to a preset temperature. “It was a more sophisticated approach than at Denby Dale, where the water in the system was too small in volume to stop the boiler cycling. The house was asking for heat but the system could not supply enough to work at full condensing capacity,” said Butcher.

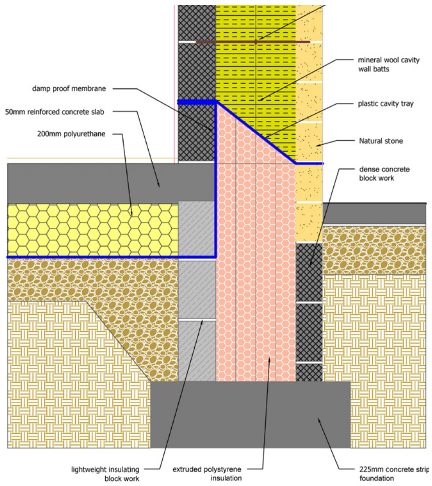
Another change from Denby Dale is the use of Compacfoam insulation — which has strong compressive strength — under the thresholds and large windows to reduce thermal bridging at those junctions. This offered an innovative, cheaper and easier solution to the problem of reducing thermal bridging at thresholds. And there were a host of smaller changes, such as painting the plywood boxes — which support the windows in the wall cavities — with an acrylic wood primer to make them weather proof and prevent the warping and delaminating as happened at Denby Dale.

Bill Butcher is proud of the Golcar house, but as a perfectionist, he thinks it has been somewhat “over-designed” and is “over-performing”. He says it is good practice to design for a space heating demand for a passive house under 15 kWh/m^2, which gives some room for error. “We aimed for 14 kWh/m^2, but due to a number of factors we ended up with 8.6 kWh/m^2, which is an over-design. We would have been happy with 13.”

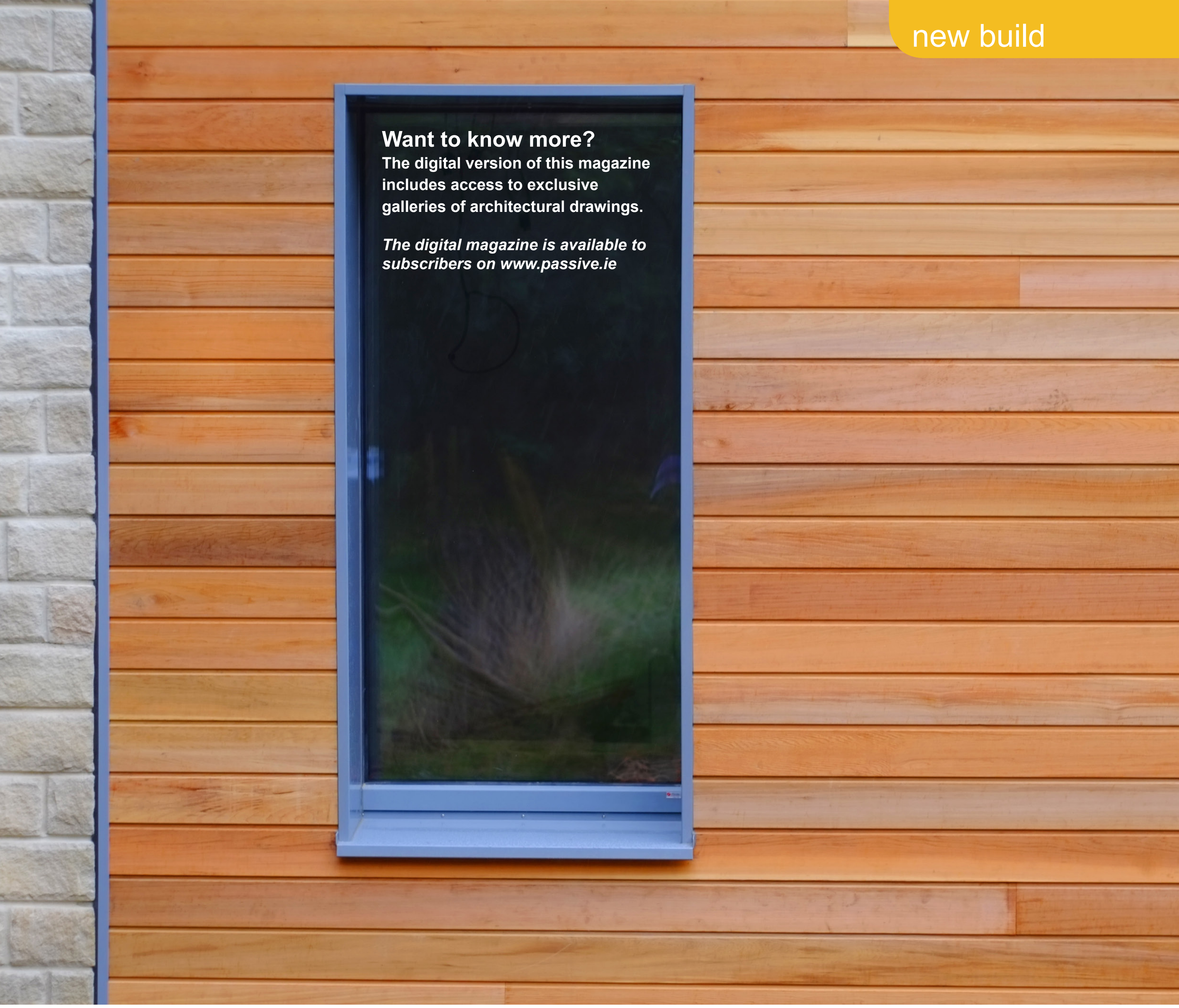
Among these factors was the late change of window specification which meant a lower U-value and greater passive solar gain. The initial PHPP calculations were also on the conservative side in terms of estimating psi values (heat losses at junctions). In addition, the airtightness test carried out by Leeds Beckett University came out better than the design team had modeled for at 0.25 air changes per hour (ACH), whereas the passive house standard only requires 0.6 ACH.

“It may appear strange to be self-critical for over-designing and surpassing the passive house requirements. What it means for this project is that we could have used less insulation in the walls and saved money. With more experience of building passive houses we can fine tune it better,” he said.

Butcher, in his spirit of total honesty, was also concerned about the dangers of overheating. “Paul and Angie had been keen to retain the large expanse of glazing that had been in the original designs. Throughout the design process we did warn them that there might be a chance of overheating as there isn’t any extra shading other than the two deciduous trees in the garden. PHPP shows that if the client is willing to open windows, it won’t overheat. So they will have to be careful to keep opening windows in the heart of summer. Alternatively, external shading could be added at a later stage.”



(above, from top) Construction of the cavity wall, showing the concrete block inner leaf, Knauf DriTherm cavity slab, and Ancon TeploTie low thermal conductivity cavity wall ties to minimise thermal bridging; Knauf XPS extruded polystyrene insulation below the damp proof membrane; diagram detailing the foundation build-up and junction with the external walls; (left) the house is situated in an idyllic location with views over the beautiful Colne Valley.



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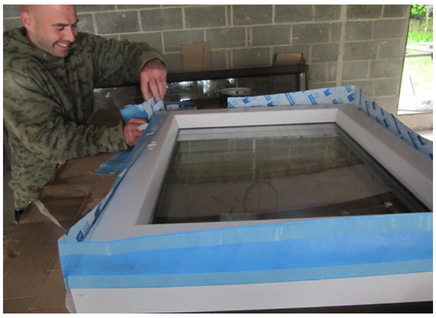

(clockwise, from top) The house features the new passive house certified Progression range of triple-glazed windows, which have a virtually invisible frame when viewed from the outside, increasing passive solar gain; application of airtightness tapes prior to window installation; insulated I-joists in roof to reduce thermal bridging, improve fit of mineral wool insulation and reduce air movement; Compacfoam rigid insulation at bay window threshold.

SELECTED PROJECT DETAILS
Clients: Paul & Angie Dallas
Architect & main contractor: Green Building Store
Civil & structural engineer: SGM Structural engineers
Passive house certifier: Warm: Low Energy Building Practice
Wall insulation: Knauf
Roof & floor insulation: Xtratherm
Airtightness products: Ecological Building Systems, via Green Building Store
Windows & doors: Progression, via Green Building Store
Roof windows: Fakro
Thermal breaks (window & door thresholds): Compacfoam, via Green Building Store
Thermal breaks (blockwork): H+H UK Ltd
Thermal breaks (wall ties): Ancon
MVHR: Paul, via Green Building Store
Airtightness tester: Centre for the Built Environment, Leeds Beckett University
Solar thermal: Eco Heat & Power
Boiler: Vaillant


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PROJECT OVERVIEW

Building type: 296 sq m four-bedroom detached private home of cavity wall construction

Location: Huddersfield, West Yorkshire

Completion date: January 2015

Budget: £398,061 (£1344 per sq m)

Passive house certification: Certified

Space heating demand (PHPP): 8.7 kWh/m²/yr

Heat load (PHPP): 8 W/m²

Primary energy demand (PHPP): 52 kWh/m²/yr

Airtightness (at 50 Pascals): 0.25 ACH

Gas consumption data (Feb 2015 to Feb 2016): 654m³ or 7316 kWh gas consumption. Divided by the treated floor area of 230 square metres gives 32 kWh/m²/yr (including cooking, water heating costs and energy consumption used for 'drying out' the house — house occupied since May 2015 but was heated since February 2015 during internal works and for drying out).

Thermal bridging: Celcon 7KN lightweight block for foundation inner leaf blockwork, Ancon TeploTie low thermal conductivity cavity wall ties, thermally broken PROGRESSION window frames, Compacfoam 200 on window and door thresholds, web of roof I-joists insulated with 25mm polyurethane along their sides to cut thermal bridging, improve fit of mineral wool insulation and reduce air movement/thermal bypass.

THE FOLLOWING PSI VALUES WERE CALCULATED:

Gable: 0.040 W/mK

Eaves: -0.011 W/mK

Slab Perimeter: -0.012 W/mK

External Corners: -0.080 W/mK

Internal Corners: 0.055 W/mK

Ridge: -0.051 W/mK

Ground floor: 150mm reinforced concrete slab insulated with 200mm Xtratherm insulation (thermal conductivity 0.022 W/mK). U value: 0.107 W/m²K

Cavity insulation below DPC: 4 X 75mm XPS Knauf Polyfoam extruded polystyrene (thermal conductivity 0.033 W/mK).

Walls: 100 mm coursed natural Yorkshire stone externally, 2 X 150mm Knauf DriTherm cavity slab 37 (thermal conductivity 0.037 W/mK) to 300mm wide cavity, 140mm dense concrete block inner leaf. U-value: 0.117 W/m²K

Roof: Natural slates externally, followed underneath by battens and counter-battens, Pro Clima Solitex wind-tightness membrane, full-fill 325 mm mineral wool insulation (thermal conductivity 0.040 W/mK) in between the 302mm I-joists, 25mm Xtratherm insulation within I-joist webs, Pro Clima Intello Plus as airtightness barrier, 50mm Xtratherm insulation (thermal conductivity 0.022 W/mK) with laminated plasterboard internally. U-value: 0.104 W/m²K

Windows: Progression passive house certified triple-glazed timber windows, with insulated frame, argon filling and an overall U-value of 0.68 W/m²K

Roof window: 3 x quadruple-glazed Fakro FTT U8 roof windows. Low e coating and warm TGI spacers. Overall U-value: 0.58 W/m²K

Heating system: Vaillant Eco Tec 612 (4.8 kW) plus bespoke 250 litre sealed thermal store with 100mm polyurethane lagging, and solar thermal array.

Ventilation: Paul Novus 300 heat recovery ventilation system. Passive House Institute certified to have heat recovery rate of 91.5%.

BREEAM excellent building marries *sustainability with world-class design*

Although Ireland's energy efficiency requirements for non-residential buildings fall far short of EU requirements, occasionally a progressive client will take matters into their own hands and push the envelope of sustainable design, such as Gas Networks Ireland's award-winning Finglas offices.

Words: Ekaterina Tikhoniouk
Additional reporting: Jeff Colley

Photos: Anthony Coleman/Paul Tierney

In its Networks Services Centre in Finglas, Gas Networks Ireland has achieved a pioneering sustainable building, whose cutting edge features include passive stack ventilation, an ingenious radiant slab heating and cooling system, and a flexible and intuitive building management strategy. The Networks Services Centre has won several awards, earlier this year adding international architecture magazine Architectural Review's prestigious Work Award to not one but two RIAI awards, a Green Award and a Concrete Society Award, and is a fine example of the fact that a building can be highly-functional and infused with sustainable innovation without having to compromise on aesthetics.

Located on a triangular site no more than 100 metres from the rumbling of the M50, the Gas Networks Ireland Networks Services Centre is a 5,200 sqm two-storey block with five courtyards, screened by an outer skin of perforated aluminium, and topped by a green roof, vent shaft and renewables tower. The centre acts as an admin, parts storage and training hub for Gas Networks Ireland, with over 240 staff members spread across its two floors.

The vision for the Networks Services Centre came about in 2008 when Gas Networks Ireland – then called Bord Gáis Networks, prior to the privatisation of Bord Gáis Energy – was undergoing a significant transformation, and the decision was made to amalgamate four of its key operations buildings in Dublin into one location. Sustainability was a key part of the brief from the onset, and one of the main focuses was achieving an Excellent rating in BREEAM, the BRE's sustainability rating system for non-residential buildings. Due to this focus, the centre became one of the first office buildings on a brownfield site in Ireland to pursue sustainability in a radical way.

The building's design was chosen via a design competition, which was won by Denis Byrne Architects. While most of the shortlisted designs proposed two separate buildings, with administration divided from ancillary services, Denis Byrne Architects' competition entry put all of the services together into one building. Denis Byrne, owner of Denis Byrne Architects, explains: "We liked the idea of a single building in order to express a democratic organisation, one where white and blue collar workers are under the one roof and share the same facilities." As well as that, one building would mean a reduced surface area in comparison to two or more separate buildings, and would therefore be easier to insulate and achieve high energy efficiency.

The key focus of the design was developing open-plan workspaces, and three-quarters of the two floors are open plan. "We wanted to create an open, permeable and informal workspace, interspersed with gardens, that would promote an inter-departmental, collaborative and humane working environment," says Byrne.

Byrne explains their approach to the building's façade: "Taking inspiration from industrial and infrastructure buildings and combining that with a sophisticated office typology, we wanted the building to assume the form of a utilitarian landmark at the edge of the city."

A strong environmental strategy was an integral part of the design and structure of the building from the very start. The building's super-insulated envelope has a U-value of 0.15 and consists of a Stanta wall system with mineral fibre insulation wrapped in a Sto external insulation system – all sitting behind a second rainscreen of anodised aluminium panels. The centre also achieved an airtightness level of 1.81m^3/m^2/hr at 50 Pascals.

Artificial lighting can be a significant proportion of a building's energy use, and maximising the use of natural daylight was one of the main drivers of the design. The largely open plan of the building is punctuated with five courtyards that allow for high levels of natural daylight in the building, which reduces the need for artificial lighting. All of the building's lighting fixtures are controlled by light detectors and dimmers, further pushing down the lighting costs.

The building has an ingenious heating and cooling strategy, which makes use of the thermal mass of the concrete slabs that form the building's ceilings to heat or cool the building as needed. Cormac O'Loughlin, Gas Networks Ireland's highly-experienced regional facilities manager, explains: "We have 27 geothermal bore holes going down 100-150 metres. During the winter months, we take in water from them at 13-15C and we put that through our ground source heat pump which heats the water up to 35C. The water then gets pumped through the pipes set into the concrete ceilings." During summer, the Dynaciat ground source heat pump is switched off, and the chilled water from the bore holes is brought straight up into the building and pumped into the ceiling slabs.

This interesting strategy means that there are fewer temperature swings throughout the working day, and the heat absorbed by the concrete ceilings is released at night, reducing the heating requirement at the start of the working day. According to O'Loughlin: "On average the temperature is probably typically between 19.5 and 22-23C, 12 months a year."

However, the heating and cooling system is not as straight-forward as it initially sounds. Each floor has ten heating zones, and the building's Trend 360 building management system allows the temperature to be adjusted in each zone. Each zone is also controlled by a thermostat; if the thermostat hits a set maximum or minimum temperature, it closes or opens the valve to let water in or out of the ceiling slab, as needed.

What is also interesting is that, unlike many typical office buildings of its size, the Networks Services Centre is ventilated naturally, using a stack effect. The air is passively sucked out through a large chimney in the centre of the building's tower, using the stack effect and wind pressure, passing through a Trane AHU CCEB DG air-handling unit with a heat recovery coil, which transfers the heat to the fresh air being brought in from outside. The air flow velocity in the extract chimney is limited to 0.5-1 m/s to limit the pressure drop.

The building's renewables tower houses a 100 sqm installation of photovoltaic panels, which largely power the ground source heat pumps. Nine banks of Carey SKY 12 CPC 5 evacuated heat tube solar thermal panels, along with Remeha gas condensing boilers, provide hot water for the building's wash basins and showers.

Such a complicated brief, with its key focus on energy efficiency, sustainability and achieving a high BREEAM standard would not be easily executed, so it's perhaps no coincidence that the contractor chosen for the job was none other than Walls Construction, the company ▸

that constructed Simmonscourt and Minerva House in the RDS, the first development in Ireland to achieve the BREEAM Excellent rating.

Their contracts manager Gareth Lloyd, was faced with many challenges during the build. One challenge was the struggle between pragmatism, sustainability and aesthetics. One example of this is the balance that needed to be struck regarding the amount of ground granulated blast-furnace slag (GGBS) put into the concrete when casting the slabs and columns. "The more GGBS you put into the concrete, the longer the concrete takes to get its full strength," Lloyd explains, "and because we were trying to do this during winter months, there was a balance between getting the green rating for the quantity of GGBS in the concrete and being able to actually construct it during the winter months without delaying the programme."

The contracting firm was meticulous in maintaining the paperwork surrounding the build. However, problems arose due to subcontractors not realising that their products should be BREEAM certified. Lloyd describes how, on a few occasions, they had to contact the BREEAM governing body regarding alternative products that didn't have ratings on their system, and had to submit all of the product's documentation, in order to receive approval that the product fulfils BREEAM criteria.

Airtightness is an important concern when attempting to reach BREEAM and passive house standards, but according to Lloyd: "With this project we actually got it first time – we had a contractor on board from day one who reviewed all of the detailing and we had strict QA requirements for airtightness."

The result of the careful consideration of sustainability and energy efficiency at design stage, and the attention to detail exhibited at construction stage, is a building that is not only beautiful and functional but also highly sustainable.

As Gas Networks Ireland regional facilities manager O'Loughlin, in primary energy terms reveals, the building consumed under 55 kWh/m^2/yr worth of natural gas and 313 kWh/m^2/yr worth of electricity in 2015. While the electricity use figures in particular might sound high compared to the figures readers may be familiar with for dwellings – for instance an A3 BER requires a primary energy total of less than 75 kWh/m^2/yr – it's important to view these figures in context. For starters, the building is constantly in use – it's occupied 24/7 due to its national distribution gas control role for Ireland and emergency response role for Dublin and surrounding counties. Then there's the fact that the building includes data centres, which tend to chew up electricity, bringing a significant primary energy penalty.

Although the fabric standards are in and around passive house levels in certain regards – the opaque element U-values range from 0.15 to 0.16 including allowances for thermal bridging – the glazed elements are some way short of the sub 1.0 U-values typical of passive houses, while still being far ahead of Ireland's non-residential building regulations. And while the passive stack ventilation system includes a passive heat recovery component, the efficiency rates are some 20 to 30% short of the sorts of levels achieved by MVHR systems typical of passive houses. These factors combined may not be an issue in offices only occupied during the day, but must surely result in more of an energy penalty for buildings in use at night too.

Remarkably for a building with several sustainability awards under its belt and a BREEAM Excellent rating, its recently published BER came out at a B3, with a score of 353.78 kWh/m^2/yr along with an energy performance coefficient of 0.86 and a carbon performance coefficient of 0.94 – meaning the building is supposedly only 14% more energy efficient and 6% less polluting than it would have been if built to the substandard Part L requirements for non-residential buildings. At first glance the accuracy of this rating would appear to be borne out by the fact that the measured energy use for the building is within 13 kWh/m^2/yr of the level

calculated in the BER.

But on deeper analysis, such a notion is shown to be nonsense. As BER assessor John McCarthy of McC McCarthy Engineering explains, the BER relied in many cases on punitive default data in the absence of certified performance data for components as per SEAI's requirements. Readers may recall a similar phenomenon occurring when BER assessor Gavin Ó Sé put Ireland's first certified passive house, passive pioneer Tomás O'Leary's 350 sqm house, through the software used for dwellings, Deap. The initial result came out at a C1 rating, again in large part due to punitive default values in the absence of paperwork that met SEAI's requirements. According to O'Leary, this house has cost circa €250 per annum for heating and hot water since the family of five moved in over a decade ago. Yet the closest example in SEAI's A Guide to Building Energy Rating for Homeowners – a C1 rated 300 sqm house – has an estimated combined heating and hot water bill of €3300. If this example seems unfair, it makes an important point: the assumptions contained in a given BER may bear little resemblance to reality, especially where default information has been used.

By way of illustration, SEAI has confirmed to Passive House Plus that the primary energy factor for electricity in SBEM, the calculation tool used to generate BERs for non-residential buildings, is currently 2.7 – a figure that's approximately ten years out of date. SEAI updates the factor with each new version of Deap, and the current factor is 2.19 – meaning that a building that only uses electrical energy would see its BER improve by 19%.

Similarly, BERs don't count so-called unregulated energy use – the energy required to run equipment, PCs etc. And in a building like this, unregulated energy use contributes a substantial amount of the total – approximately 45% of the electrical load, based on Gas Networks Ireland's energy monitoring data, meaning the 313 kWh/m^2/yr primary energy figure drops to circa 173 kWh/m^2/yr, or 228 kWh/m^2/yr including gas use too.

But the process of preparing this article has provided the opportunity to reappraise the building's BER. Although the level of technical information that Passive House Plus demands of the buildings featured in these pages can be onerous, it does result in useful data emerging. In the absence of available date for the BER, John McCarthy relied on default data for all U-values, heat pump efficiency, airtightness, thermal bridging, solar transmittance factors from glazing, and air leakage rates from ductwork for ventilation and cooling systems. Although it's not clear that all of the data Passive House Plus gathered would have the necessary paperwork for SEAI to permit its use, we asked McCarthy to re-run the calcs based on adding in some of the missing data – U-values, airtightness test result and heat pump efficiency. The BER shot up from a B3 to a B1, and a score of 236.6 kWh/m^2/yr. When the primary energy factor for electricity was updated too, it reduced the total to circa 192 kWh/m^2/yr and an A3 rating. What's more the EPC fell to 0.47 – coming in 53% lower than Part L requires.

The original specification was to provide energy savings of at least 40% relative to a typical low-energy office. The performance of the Networks Services Centre is, in fact, exceeding its design requirements. In terms of overall energy use, the centre currently consumes 45% less than a typical low energy building, and 50-60% lower than the company's other buildings. The photovoltaic panels and the solar water system on its south elevation provide up to 10% of the building's electricity demand, with the photovoltaic panels generating approximately 7,000kWh per annum, enough electricity to largely power the building's ground source heat pumps.

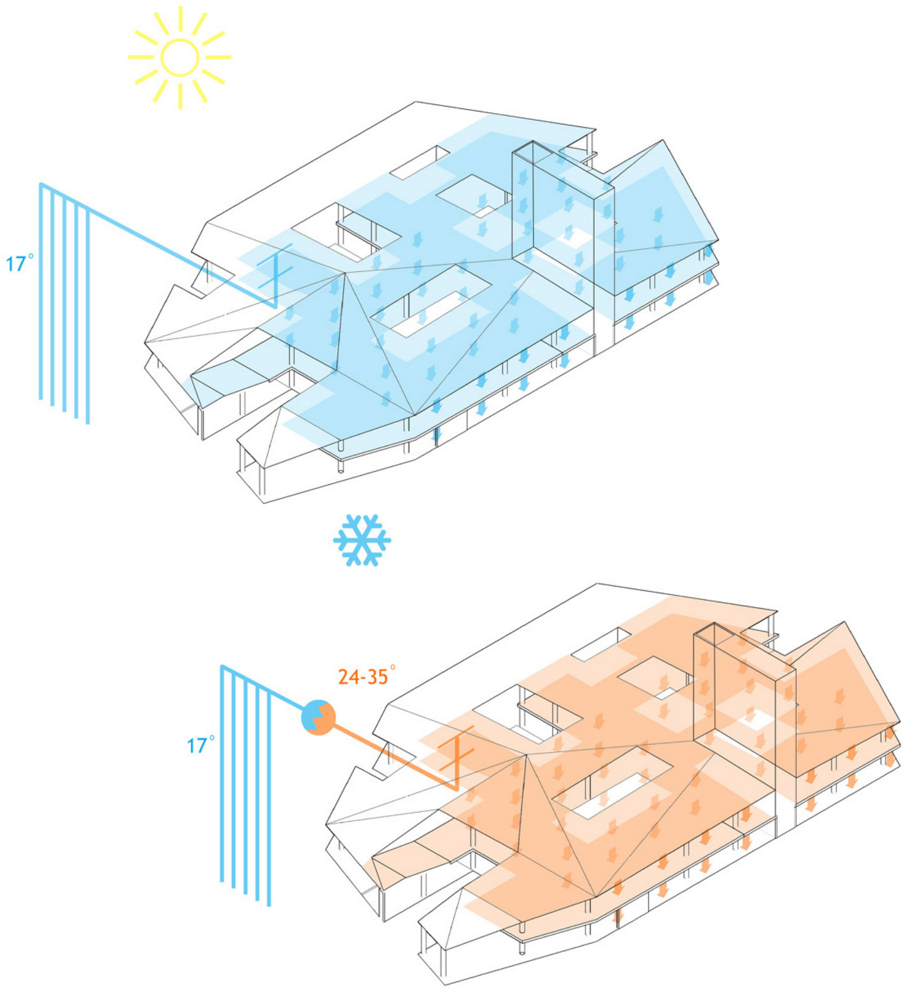
The building also provides high levels of occupant satisfaction. According to the Networks Services Centre's HR department, the staff are extremely pleased with the building. Comments from staff include statements such as: "The roof garden is a great addition, given that we are able to use it all year round," and remarks that "Great natural light comes into the building through the internal gardens."

And the small number of staff complaints submitted every year also speaks for itself. "In my experience, there will always be complaints," O'Loughlin explains. "But then again, we only had 20 complaints logged for this site since January this year until today, and on another site they had 180. It demonstrated the different approach we use at the Networks Services Centre – the other site has a traditional VRV system where you have air conditioning in the ceiling blowing down on people. While here we don't have that system."

However, O'Loughlin explains that, as with any new building, there will always be hiccups. It certainly wasn't all plain sailing in this case either. Due to the complex systems installed, calibrating the building to work exactly as he wants it to is not as straightforward as it seems. "It took me 9-12 months to get the building running exactly the way I wanted it to," O'Loughlin states, "and then because of the complexity of the systems... we had teething issues with the heating and the cooling but that has settled down in the last couple of years."

O'Loughlin explains that, because of the radiant slab heating and cooling strategy used, the building isn't quite as responsive as a building that uses more traditional heating systems. Yet, as mentioned previously, this slow responsiveness can also be a bonus. "The upside to the slow responsiveness of the Networks Services Centre is that when you switch the heating off, the building doesn't lose that much heat," says O'Loughlin. "This means that the building can sometimes remain unheated over a weekend and only lose 2C of heat!"

SELECTED PROJECT DETAILS
Client: Bord Gáis Networks
Architects: Denis Byrne Architects (Design team: Sean Attley, Serena Bastianelli, Roland Bosbach (Project Architect), Denis Byrne, Louise Clavin, Dave English, Gosia Meder, Marcus Reid, Gustavo Sapina.)
Landscape architects: Topotek 1 (with Cunnane Stratton Reynolds)
Environmental consultants: Transsolar
Structural, civil & M+E engineers & BREEAM assessor: Buro Happold
Façade consultant: Buro Happold / FSA
Project management and quantity surveying: Long O'Donnell
Acoustic consultant: AWN
Ecologist: Open Field
Transport consultant: MVA
Airtightness testing: BE Technologies
Contractor: Walls Construction
M+E contractor: Mercury Engineering
Groundworks & drainage: D Wall & Co Ltd
Concrete & formwork contractor: SMG Construction Ltd
Roofing contractor: Crown Roofing
Flooring contractor: Aston Carpets & Flooring
External insulation system: Sto
Floor insulation: Kingspan
Roofing materials & warranty: Bauder
Airtightness membrane: Siga
Roof light, curtain walling, windows, glazing, cladding & roller shutters: Alucraft
Façade blinds & tower louvres: Crossflow Ltd
Wall system: Stanta Crowley Ltd.
Steel doors: Dimension Engineering
Raised access flooring: Cableplan Ltd
Heat pump: Ciat
Solar thermal & PV: Carey Glass Solar
Gas boilers: Remeha
Air handling units: Trane
BMS: Trend, via Standard Controls
Carpets: Shaw Contract, via Walls 2 Workstations
Rubber flooring: Artigo
Vinyl flooring: Polyflor
Entrance system: Matwells
Concrete formwork: U-Boot, via SDG Construction Technology Ltd
Concrete, including GGBS: Roadstone
Radon barrier, tanking & waterproofing: Baridek
Plasterboard: Gyproc
Extruded aluminium: Hydro
Cement fibre board: Versapanel
Structural steelwork: Leonard Engineering
Secondary steelwork, handrails & balustrades: Peterson Manufacturing Ltd
Tower stairs steelwork & bird mesh: Swift Engineering
Rainwater goods: Alumasc
Acoustic baffles: Tennants Ireland Ltd
Suspended ceilings, metal ceilings, partitions, drylining & acoustic baffle installers: ACS Ireland
Lindner wall cladding, doors, screens & partition systems: Allied Workspace
Internal fireproofing: Fireseal
Timber doors: Fire Doors & Joinery
Ironmongery supply: Elementer



(Above, from top) A diagram shows how the building's vertical bore hole collectors will be used to provide active heating (above) via a heat pump and passive cooling (top), which can bypass the heat pump when the ground temperatures are at sufficient levels.

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The digital magazine is available to subscribers on www.passive.ie

PROJECT OVERVIEW

Building type: Detached two-storey 5,200 sqm building to accommodate up to 315 staff, constructed of cast-concrete structural slabs and 9m column grid.

The new building incorporates a number of primary functions including: 24/7 national distribution gas control for Ireland, 24/7 emergency response for Dublin and surrounding counties, national training centre, national distribution safety and quality centre, and national distribution operations and construction departments.

Location: St. Margaret's Road, Dubber Cross, Finglas, Dublin 11, Ireland.

Completion date: December 2011

Budget: €14 million

Passive house certification: N/A

Energy performance coefficient (EPC): 0.86

Carbon performance coefficient (CPC): 094

BER: B3 (353.78 kWh/m²/yr)

Environmental assessment method: The Networks Services Centre is rated under the 'bespoke building' BREEAM category, and has a BREEAM Excellent rating

Measured primary energy consumption: Natural gas 54.78 kWh/m²/yr consumption (Jan-Dec 2015)

Electrical 313 kWh/m²/yr consumption (Jan-Dec 2015) including data centres,or 228 kWh/m²/yr minus unregulated energy use.

Airtightness: 1.81m³/m²/hr at 50 Pa.

Ground floor: 150mm concrete floor slab featuring 50% GGBS on 60mm Kingspan Thermafloor TF70 insulation. U-value of 0.16 helped by low perimeter to wall ratio.

Floor finishes variously include Greenguard Gold certified 3mm Artigo Multifloor Uni, BRE Green Guide A+ rated 2.5mm Polyflor Polysafe and Shaw Contract Gradient carpets featuring Ecoworx backing system – low embodied energy, low VOC, 100% recyclable & including recycle content; and Matwells proprietary aluminum profile interior entrance system.

External Wall: 890 sqm Stanta wall system comprising of (inside to out) skim coat; 12.5mm fire resistant plasterboard; 18mm WBP plywood; counter battened 22mm insulation layer; Siga Majpell airtight membrane; 12mm Pyroc cement fibre board; 150mm friction fitted mineral wool insulation fitted between Stanta steel studs; 12mm Pyroc cement fibre board; 130mm adhesively fixed EPS insulation using Sto Turbofix system; Sto Armat Classic base coat with reinforcing mesh; 1.5mm Sto Lit K acrylic finish coat; structural steel framework; 4mm anodised aluminium rainscreen cladding, including perforated sections. U-value: 0.15

Internal walls (Metal stud partition): Gyproc plasterboard either side of a metal stud partition system; stud partition with metal surface cladding system; glazed partition without metal studs; fire-resistant glazed internal partition; retractable folding partition system with sound insulation.

Bauder green roof system comprising of Plant-E capping sheet, Baudertec KSA Duo underlayer, 150mm Bauder FA-TE PIR insulation on Baudertherm DS1 Duo vapour barrier, on 2851 sqm 200mm reinforced in-situ concrete biaxial slab with U-Boot recycled plastic formwork utilised to reduce dead load concrete (circa 30% concrete reduction). Concrete includes 50% GGBS cement. (30mm Bauder FA-TE insulation to upstands of parapet.) U-value: 0.15

Upper floor slab: 1938 sqm reinforced in-situ concrete biaxial slab with with U-Boot recycled plastic formwork to reduce dead load concrete as above. Concrete includes 50% GGBS.

Glazing: Aluminium curtain walling system and punched window system. Glazing U-values of 1.1 W/m²K, and overall U-values of 1.4 W/m²K

Roof light over gas control area. Glazing U-values: 1.1 W/m²K. U-value: 1.8 W/m²K

Heating & cooling system: A ground source heat pump feeds into the building's radiant slab system, with heating and cooling pipes set in the exposed concrete ceilings to dampen temperature swings through the working day and reduce overall ventilation requirements. Heat absorbed by the concrete ceilings is released at night reducing the heating requirement at the start of the working day. The radiant slab, similar to a tiled stove, enables lower ambient temperatures compared to conventionally heated office spaces.

Heat pump: Eurovent-certified Ciat ground source heat pumps linked to 27 vertical bore holes. 99 kW heating capacity (COP of 4.01). Cooling capacity: 74.3 kW (ESEER: 5.69)

Gas boilers: Remeha Quinta Pro 115 high efficiency condensing gas boilers: 110% NCV at 40/30C (99% GCV)

Solar thermal collector: The south elevation of the tower also contains 24 sqm of Carey Sky 12 CPC 5 solar thermal collectors providing hot water for the kitchens, washrooms and showers, with a 1500 litre insulated stainless steel storage tank, and 316 litre DHW accumulation tank.

Ventilation: Displacement ventilation system for the office areas with passive ventilation for the canteen, workshops and stores. The displacement ventilation relies on natural air movement between the assisted fresh air supply at floor level and a controlled extraction via a central chimney at the apex of the folding roof. The chimney is contained within a plant tower and uses a natural stack effect for extraction and contains coils for heat recovery.

Main air handling unit: Trane CCEB DG 7,5/6 - heat recovery ventilation system, with a heat recovery rate of 59% with run around coil.

Restaurant air handling unit: Trane CCEB DG 2,2/5

Electricity: 100 sqm of Carey Glass Solar photovoltaic panels fitted at a fixed angle of 30° to the south elevation of the plant tower providing up to 11,000 kWh of electricity per year.

Water: The water management of the landscape strategy seeks to treat as much surface water run off on-site as possible with a series of natural attenuation and filtration areas for the car parking and a large attenuation pond to the south of the building.

Green materials: GGBS, low VOC materials, and attention to sourcing materials based on green criteria generally, in terms of the BRE Green Guide to Product Specification, EPDs, etc.

Ground-breaking housing scheme

captures one developer's journey to passive...

The just-finished second phase of Durkan Residential's ambitious Silken Park scheme in south-west Dublin bridges the gap between two extremes: while phase one was built to the 2002 building regulations, phase three — which will break ground next year — will comprise 59 passive certified units.

Words: John Hearne

(above) The ground floor features 150mm of Xtratherm insulation under the concrete slab and 100mm Xtratherm as an upstand to the inside of the blockwork around the entire perimeter to reduce thermal bridging.

When phase one of the Silken Park development in City West, Dublin was completed in 2007, the 22 apartments and 33 houses were built to 2002 regulations, and featured partial fill cavity walls and permanent wall vents, with no provision for airtightness. Phase two, which was completed recently, includes 15 houses. Each boasts highly insulated, single leaf walls, airtightness that in many cases beat passive house levels, and demand controlled ventilation.

And phase three – on which work has begun – will showcase 59 certified passive houses. Once complete, it will be, by some distance, the largest passive house development in Ireland. Though the company behind Silken Park is a well-known large scale developer, Durkan Residential is family run — by brothers Patrick and Barry Durkan. Through the early part of the last decade, they specialised in housing for first time buyers, and completed major residential developments in Finglas and Greystones. Silken Park was very much in that mould. Back then, the company sought and received permission for 149 units, completing the first 55 in 2007.

"We were focused hugely on finish," says Patrick Durkan. "We did superior kitchens, quartz worktops, Rationel windows...Although an entry level home, we put a lot of emphasis on interior design and getting a really high quality finish." Then the crash hit and everything stopped. Phases two and three of Silken Park went into mothballs, the planning permission expired and nothing happened for nearly seven years.

By the time the Durkans were able to realistically consider starting again, everything had changed. The building regs were significantly tighter, as were lending conditions, while the market itself was unrecognisable from the heady days of the mid-noughties. The one thing that remained the same was the company's commitment to delivering a quality product. But while that commitment used to manifest itself in finishes and interior design, it now found a new means of expression.

During the downturn, the Durkans had closely followed developments in the only corner of the building industry that showed any signs of life – the refurb market. They had seen how emerging insulation techniques and products could transform substandard housing stock.

Other factors were also at play. "There were a variety of influences," says Patrick. "What was going on in Europe, the refurbishment market, the implementation of BCAR, Part L. We became focused on achieving a more cost-effective house without compromising the product."

Looking around at how other developers were reacting to these influences, he saw both bad and good. "A lot of developers throwing PV on roofs, or sticking in heat pumps...piling on renewables. We said, why not focus on building a better house, so you don't need to place too much emphasis on renewable technologies to reach targets."

To realise this ambition, the Durkans brought architect and sustainable design consultant Jay Stuart – technical director of Durkan's building fabric contracting company, Ecofix – on board and charged him with coming up with a specification that would deliver low energy at low cost.

"The objective for the phase two houses," says Stuart, "was to build better houses by focusing on integrating a designed ventilation system, a high degree of airtightness, minimal thermal bridging and high thermal performance."

He knew that if the build team could achieve this, they would deliver healthy houses with almost no risk of condensation, high indoor air quality, a high degree of thermal comfort and low heating costs. "The challenge was achieving a high degree of airtightness and minimal thermal bridging cost effectively, with some standard and some innovative but simple details."

To that end, Stuart set about creating a series of construction details that could be applied uniformly across all units in phase two. Each one was subject to analysis by industry-leading professionals, to ensure they delivered across a range of criteria, including U-values, thermal bridging and Deap assessment.

Take just one of the details that Stuart zeroed in on: the gang nail roof truss. Ubiquitous in roof construction in Ireland, it has, says Stuart, represented something of a weak point in the insulated envelope. "When you're talking about current regs, you need quite a thickness of insulation, but that insulation gets pinched by the geometry of the house at the junction of the wall plate. And what happens inside the house? Hot air rises, it carries humidity with it and it condenses wherever there's a thermal bridge or a reduction in insulation, and that's really in the corner of all bedrooms in all houses. If you solve that junction, you improve all sorts of things, including reducing the risk of condensation."

Taking up that challenge, Stuart sat down and designed a new detail that would overcome this weakness. He had it tested to ensure it delivered optimal performance, and then took it to Durkan to find out what kind of premium would be required to deliver that specification. The answer was zero. "A little bit of thinking costs nothing," says Stuart, "Good detailing is not expensive."

He goes on to say that the view expressed by some sections of the industry, that more demanding building standards somehow inhibit construction activity by driving up costs, has no basis in fact. Patrick Durkan agrees. He says that the decision to go for such a high spec product in phase two, and a fully passive one in phase three, was market-led.

"The challenge was to work with our financial partners to build something that was really

(above, from top) Rockwool's REDArt Silicone external insulation system being fitted to the concrete block walls; installation of the windows flush with the external insulation layer; the exterior walls are clad with the BrickShield system to create a real brick finish.

cost-effective but make it as efficient and attractive and saleable as possible...We don't talk about eco or green or passive. Believe it or not, that's just a by-product of what we're marketing."

And nor will you see the words 'green' or even 'passive' in Durkans' Silken Park brochure. As far as the market is concerned, price trumps all other variables. Central bank lending restrictions have been instrumental in choking off funding for first time buyers, making price the most important variable for those looking to get a foot on the property ladder.

"The market is about value for money, the market is about affordability," says Durkan. "In terms of people getting mortgages, we need to be very conscious of the price point...We have to deliver these houses at a price that satisfies our investors. That's the challenge."

In addition to drawing up those critical construction details, Jay Stuart also drew on his extensive work in the retrofit market with Ecofix to specify external wall insulation on all units. "The major change and biggest saving was to build the external walls as single leaf hollow block, externally insulated with Rockwool EWI systems," says Stuart, who commissioned Wufi calculations to be certain that Rockwool – in this case variously finished with Rockwool's REDArt Silicone and BrickShield external insulation systems, which features a real brick finish – would work with single leaf block walls in this climate.

The calculations showed that the moisture content of the whole construction decreased over time and that the thermal performance was good and in line with standard U-value calculations. To repeat, these are hollow-block walls – the much-denigrated staple of Irish house-building that has persisted for so long in the Dublin region in particular. Jay Stuart points out however that EWI makes the build method less important than you would think.

"If you're using external insulation, you could build the single leaf masonry wall from anything. Once it's structurally stable, and the engineer's happy with it, I don't care what it is." Stuart's point is well made. The thermal performance and interstitial condensation issues associated with hollow block construction were really about the combination of leaky plasterboard and internal wall insulation that typically went with it. As Joseph Little's seminal Breaking the Mould series of articles in this magazine's predecessor, Construct Ireland, showed, dry lined hollow block walls may present a significant risk of interstitial mould. The failing lies with the build-up, not with hollow blocks per se.

The method chosen at Silken Park also had the major cost advantage of going up very quickly – reducing build times to 14-16 weeks compared to 18 weeks for a cavity wall house. On phase one, the build team took no real airtightness measures, as the notion of sealing buildings up was in its infancy in Ireland at the time. On phase two however, the airtightness strategy was exemplary, and delivered results as low as 0.29 ACH – among the best results ever achieved in this country – ably assisted by experienced airtightness contractor Roman Szypura of Clioma House.

With great airtightness comes great ventilation – or at least it should. In phase two of Silken Park, the decision was taken to go with an Aereco demand controlled mechanical extract ventilation system. There are two major advantages to this system — it's maintenance free and has exceptionally low running costs. It does tend to be less efficient than heat recovery ventilation, says Jay Stuart, but tests have suggested that the shortfall is only in the order of 8 to 12 per cent.

In order to meet the renewable energy obligations under Part L of the building regulations, a kilowatt worth of solar PV panels from Warik Energy was placed on the roofs of the phase two homes. And as this phase approaches completion, the design and build teams will soon turn their attention to the 59 fully certified passive houses that will comprise phase three.

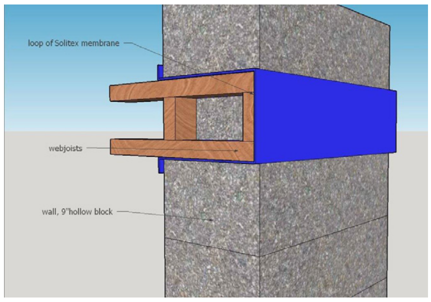
"We've wanted to get to passive house, to a new standard of construction," says Patrick Durkan. "But we didn't want to jump straight there, that would have been too great a departure for us."

The reality however is because of the build quality in phase two, going that final step to passive is no more than that, a step. A report by James Walsh of Low Energy Design revealed that only a few changes have to be made to the specification. The demand controlled ventilation system will be replaced by MVHR, the windows will be upgraded to triple-glazed while the building envelope will need a slight increase in insulation levels – with 40mm more Rockwool for the external insulation system.

In addition, the design team has decided to streamline systems within the new units by going for all electric appliances and equipment. Patrick Durkan is looking to the day when phase three homeowners can put PV on the roofs of their houses to take care of their energy needs, and perhaps even sell energy back to the grid.

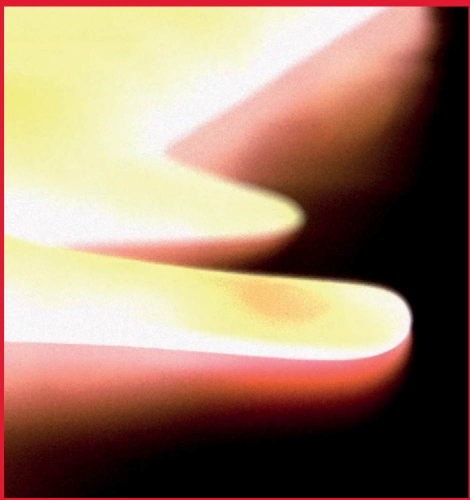
With this in mind, Jay Stuart says that there may be an opportunity to build a zero energy house in this phase.

"If so," he says, "it will be among the first commercially built NZEB houses in Ireland. We know how to do it and we know the costs but we'll all have to wait to see what happens. There is more to be learned and we will share our journey in the next chapter of our story."



(above, from top) Pro Clima Intello membrane fitted to the underside of ceiling rafter; careful taping at window reveals; webjoists are wrapped in membrane for an airtight loop, membrane taped back to the wall with Solido plasterable tape and for extra safety, the plasterer plastered over as much surface as possible – even between webjoists and over the membrane.

(above) Ventilation is provided by an Aereco demand controlled mechanical extract ventilation system, with humidity sensitive air inlets.



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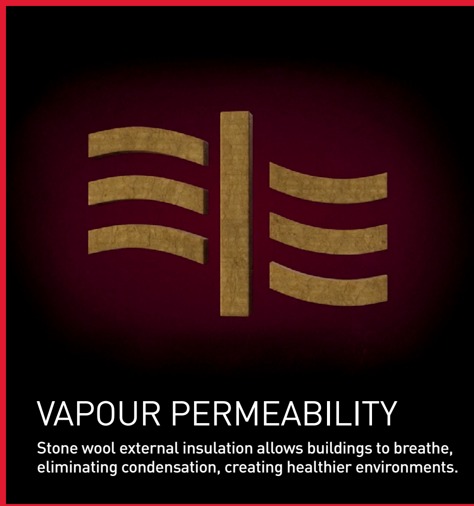

ROCKWOOL®

SELECTED PROJECT DETAILS
Developer: Durkan Residential
Architect: BBA Architecture
Main contractor: Durkan Residential
M&E Engineer:
Murphy Belton Consulting Engineers
Civil & structural services:
O'Connor Sutton Cronin & Associates
Energy consultant: Low Energy Design
Mechanical contractor:
Mowlds Heating and Plumbing
Electrical contractor: JP Byrne & Company
Airtightness contractor: Clioma House
Airtightness testing:
Building Envelope Technologies
External wall insulation: Rockwool
Building envelope & airtightness contractor: Ecofix
Roof & floor insulation: Heiton Buckleys
Airtightness products:
Ecological Building Systems
Windows & doors: Rationel Vindeur
Demand controlled ventilation: Aereco
Solar PV: Warik Energy
Fit out: Cawleys Furniture
Roofing supplier: Roadstone
Roofing contractor: Neal Brennan
Landscaping: Redlough Landscaping
Sand/cement render (airtight layer):
Kilsaran

(Above) A blower door test was carried out by Building Envelope Technologies to measure the air leakages in the building; with smoke pencils used to identify localised leakage.

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The airtightness strategy delivered results as low as 0.29 ACH – among the best results ever achieved in Ireland.


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PROJECT OVERVIEW

Building type: Phase two of private development, consisting of a mix of terrace and semi-detached. Eight two-storey terraced houses (74.5m²), six three-bed semi-detached houses (90.8m²), and one four-bed detached house (125.8m²).

Location: Citywest, Co. Dublin.

Completion date: March 2016

Budget: €5M

Passive house certification: N/A

PHPP/DEAP figures below are for three-bedroom, semi-detached units

Space heating demand (PHPP): 51kWh/m²/yr

Heat load (PHPP): 18 W/m²

Primary energy demand (PHPP): 118 kWh/m²/yr

Energy performance coefficient (EPC): 0.393

Carbon performance coefficient (CPC): 0.344

BER: A3

Environmental assessment method: N/A

Airtightness: 9 of the 15 houses in phase 2 achieved less than 0.534 ACH at 50 Pa, well below the passive house target. The worst airtightness test result on completion was 0.812 ACH at 50 Pa.

Thermal bridging: Floor slab built using a traditional strip foundation, plinth insulated with dense/waterproof EPS right down to the foundation. Fixed 100mm Xtratherm as an upstand to the inside of the block around the entire perimeter. Joist junction using Durkan details: 0.077 W/mK. The brief was to draw a continuous line around the building and ensure the thermal line remained intact. Using Durkan's own details all doors and windows are set in the insulation zone. Roof junction detail worked very well ensuring adequate ventilation. Not breaking thermal line has proven difficult here because of the tight angle, however by changing truss details slightly a psi-value of 0.077 W/mK was achieved.

Ground floor: Strip foundation using concrete blocks,150mm Xtratherm insulation, concrete slab. U-value: 0.15 W/m²K

Walls: Single leaf 215mm concrete block wall finished externally with Rockwool's REDArt Silicone and BrickShield external insulation systems, including 160mm Rockwool semi-rigid insulation and 15mm sand/cement render internally as the airtight layer. 16mm electrical services zone and 12.5mm plasterboard on dabs finished with wet skim coat plaster. U-value: 0.20 W/m²K

Roof: Roadstone black concrete roof tiles, on 50X35mm battens, followed underneath by breathable Pro Clima Solitex underlay, attic trusses as designed by Shannonside Engineering fully fitted with 100 Knauf Ecose insulation, fitted between joists with another 150mm criss crossed over, with a final layer of 100mm crossed over. Pro Clima Intello membrane tacked to underside of ceiling rafter and taped at overlaps and wall junctions. 25mm battens countersunk into rafter for service void. 12.5mm plasterboard ceiling and skimmed internally. U-value: 0.1 W/m²K

Windows: Rationel Aura Range double glazed timber windows. FSC-certified laminated Scandinavian pine. Fully certified by the Wood Window Alliance. Overall U-value: 1.34-1.62 W/m²K

Heating system: Vokera Mynute I20 modulating 92% efficient condensing gas boiler supplying heating to conventional wall radiators and 300 litre buffer tank.

Ventilation: Aereco demand controlled mechanical extract ventilation system.

Electricity: Four 250W solar PV panels per dwelling.

Green materials: All timber furniture from FSC/PEFC certified sources.

Photos: Paul Pickard

Solihull upgrade

trials revolutionary retrofit approach

An exciting and innovative new deep retrofit project in Solihull has drastically cut the energy consumption of a small block of flats by smoothly and efficiently wrapping the entire structure in both insulation and ventilation ducting, delivering huge energy savings and minimal disturbance to the residents.

Words: Ben Adam-Smith

We're all well aware that our existing housing stock is not up to scratch and that — for reasons including climate change, comfort, health and wellbeing — mass retrofitting is essential. A few exemplar projects have shown us the light. There have also been government initiatives encouraging us to take action, yet progress is minimal and certainly not at the rate needed to make all of our housing zero carbon by 2050. That is also putting to one side the hundreds of thousands of new buildings that do little to get beyond building regulations and therefore will ultimately need to be retrofitted at some point in the future. It's a painful situation.

So what is going wrong? Matthew Rhodes, managing director at passive house consultancy Encraft, believes that economics is one of the key barriers. "It is simply very expensive to design and deliver bespoke solutions for every existing building in the country, given the tremendous variety in our housing stock. I also think there is a paradigm problem, in that we do tend to look for one-size fits all solutions, and shortcuts on quality to minimise cost, and this approach simply won't work when crudely applied to existing buildings," he says.

An opportunity arose to pilot a new approach when Innovate UK launched their Scaling-up Retrofit competition, which encourages applicants to re-think supply chains and deliver a price-focused deep retrofit proposal with performance guarantees for customers. Encraft submitted a proposal, alongside partners Beattie Passive, Solihull Metropolitan Borough Council, Solihull Community Housing and Coventry University – to trial a whole building retrofit solution called OWLS (off-site wrap-around large scale retrofit) and this project in Solihull went on to become one of only nine projects in the UK to receive funding.

Matthew Rhodes explains how it works. "The core idea of the OWLS project is that instead of looking for a single system or technical solution to work for as many buildings as possible, we focused instead on simplifying the process of retrofitting to reduce cost as much as possible, while being rigorous around quality."

As part of the competition this all-in-one solution, which minimises thermal bridging and aims to achieve the Passive House Institute's retrofit standard, Enerphit, would be applied to a low-rise block of flats.

Encraft was keen to work with Beattie Passive on the project because they liked the simplicity and adaptability of Beattie's timber-frame building system— and also the way Beattie are willing to work with local people to transfer construction skills. But while Beattie Passive's system has been used hundreds of times for passive house new builds, it's early days for its use in retrofit.

Ron Beattie, managing director of Beattie Passive, says he has always envisaged that the company's new build system would transfer to retrofit. "What we needed to come up with, and what the innovation that we did was, how we get a new building over the top of an old building, and how we can incorporate the MVHR system."

A common analogy when explaining how passive house insulation works is that it's like putting a tea cosy around a teapot. Well, Beattie Passive has created their own retrofit system which they've called TCosy (a term they've trademarked). It's a deep retrofit and ventilation system all in one.

"The future of retrofit is going to be a very simple process that will use 3D printing machines."

Having first been applied in Oxfordshire to extend and retrofit a private dwelling, it was now ready for a bigger trial on one of Solihull Community Housing's properties.

Mark Pinnell, head of asset management at Solihull Community Housing, explains how they got involved: "We were asked to participate in this collaborative project designed to test out retrofitting of a passive standard insulation system on an existing residential block of flats. We had no previous experience of installing this type of insulation but were aware of the benefits so were very keen to be involved. We have a strong commitment to improving the energy efficiency of our homes and this project makes a real contribution."

Finding a suitable candidate building was actually quite challenging. Dr Sarah Price, senior consultant at Encraft, explains the type of building they were looking for. "It had to be hard to treat so it had to be one of the sort of post-war system builds which are often just concrete, brick, a mixture of all sorts of things, nobody really knows how they were built. We wanted a low rise flat because all their high rises have been done, or are in the process of being done. And there's a lot of solutions out there for high rise and a lot of funding for high rise so we needed something for the smaller blocks."

Ultimately it came down to a choice of two buildings where all of the occupants were Solihull Community Housing tenants. Other blocks of this type, for example, had one or two flats in private ownership. Grandys Croft, a rectilinear building comprising six flats, was chosen.

The process for this retrofit started with a survey of the existing building, including a thermal survey and airtightness test, to assess its structural condition.

Ron Beattie outlines the next steps: "We then do a project plan with the client and we look at digging a hole around the external part of the building and that's going to go 600mm down to the foundations. And that means that of course all our existing drains and services that are in around that area, need to be repositioned because what we're going to do is we're going to drop a new TCosy, a new house form, over the top of the existing building."

An inspection of the foundations can then establish whether the new structure can be hung off the existing foundations or whether some new foundation blocks might need to be introduced. "Once that's done we then create a DPM [damp proof membrane] that runs around the building and is sealed off at damp course level. And damp course level is the level just underneath your door plate, the sill in your door which normally runs and stops any moisture ▶

(below) On site during the retrofit of Grandys Croft, including a view of how the building looked prior to the installation of the new TCosy system and render board externally.

(left to right) The MVHR units are located outside of the flats to avoid disturbance to tenants when maintenance is necessary; installation of the Beattie Passive TCosy retrofit system that was installed externally; MVHR ductwork was incorporated into the TCosy system to minimise the internal works normally required with the retrofitting of such systems.

rising up the building. We don't want to bridge that DPM so we seal our new box up to that point and that stops any moisture then rising up above the DPM."

"We then put a shoe which is either bolted or connected to the foundation brickwork, or a new foot that sits down to a new foundation." This is where the prefabricated panels, complete with ventilation ductwork, doors and some of the finishes, can be dropped in.

The TCosy system at Grandys Croft was constructed on site. And the innovation of integrating the MVHR externally was in response to a specific problem.

Sarah Price says: "The ventilation actually changed from natural ventilation to mechanical ventilation halfway through the build because really Beattie Passive system is an airtight system, and they always have MVHR in all of their new builds. So they really wanted MVHR but the problem was we couldn't put it inside the flats. We couldn't install the ductwork inside the flats. So they were trying to find a way to get the ductwork into this retrofit and it wasn't until quite late on that they actually came up with these designs. So that was a real change."

By creating a void around the outside of the building and then incorporating the MVHR system within that, it became possible to alter the ventilation strategy. Sarah continues: "Total Home Environment did all the calculations for the ductwork, flows and the pressure drop and the noise levels, they are really experts in MVHR design. They estimated that actually it would work with the long ductworks. So we trusted their calculations and their experience and they came and installed it and commissioned it."

A benefit of locating the MVHR units outside of the flats is that maintenance – including replacing filters in the units – can be done without disturbing tenants. But there are also filters on the kitchen extract valve in each flat to prevent grease getting into the ductwork. As Solihull will be accessing the flats once a year to service the boiler and to run gas safety checks, replacement of these filters has been built into that regime.

Part of Coventry University's monitoring will ascertain whether each flat has the desired indoor air quality, given the unusual MVHR configuration. If so, it offers a tantalising prospect for deep retrofits: the ability to keep occupants in their homes during the retrofit and limit disruption.

Mark Pinnell from Solihull Community Housing says: "As with any major retrofit or refurbishment project the key is managing the impact on the residents and ensuring there is constant and proactive communication with them. We were fortunate in that Beattie Passive managed this part of the project extremely well."

Beattie Passive also injected quite a bit of finance into this project, but see this as an important investment for the future. Ron says: "The lessons we've learned have let us jump two or three years."

With so much variation in our existing buildings Ron believes flexibility is essential in future manufactured retrofit solutions. "The future of retrofit is going to be a very simple process that will use 3D printing machines. We will look at façades, we will stand them up in front, and then we will inject them with insulation. And that will be a very quick, fast process down to a couple of days of on-site work. Looking however you want it to – brickwork, render, stonework. It will all be able to be reproduced in the future."

For Encraft, this project highlighted the human side of things too. Matthew Rhodes explains: "The key thing is to focus on skills and standards in the project team, not just on technologies and systems. This includes soft skills, like dealing with occupants so that they co-operate during the project and can get the best out of the building once the project is complete."

As part of Encraft's work into scaling up and rolling out retrofit, they produced a paper looking into the cost of retrofit. Sarah Price recalls: "This three-storey block of six flats is on the borderline of what would pay back. So it would pay back in about 30 years on tenants' bills."

This assumes being able to recoup the savings on the tenants' bills. "There's a lot of nervousness out there from social landlords about service charges in particular. Because if you get into rent arrears you can't recoup the costs of the service charge in court." Making retrofit stack up financially is still a core issue when it comes to wide-scale uptake.

For now, everyone is pleased with this outcome. By all reports the residents at Grandys Croft have been very positive about the refurbished building, though they have yet to experience the benefits during the colder winter months.

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The digital magazine is available to subscribers on www.passive.ie

SELECTED PROJECT DETAILS

Client: Solihull Community Housing
Architect: Beattie Passive Retrofit
Main contractor: Beattie Passive Retrofit
Build system supplier: Beattie Passive Retrofit
Energy consultant: Encraft
Civil & structural engineering: Canham Consulting
MVHR: Total Home Environment
Electrical contractor: Corrigan Electrical
Airtightness tester & thermal imaging: Air Testing UK
Wall insulation: Springvale
Roof insulation: Springvale
Airtightness products: PYC Systems
Airtightness products: EH Smith
Windows: Elwiz SA
Entrance door: Warrior Doors
Cladding: Steni
Roofing: JMG Roofing

PROJECT OVERVIEW

Building type: A three-storey block containing six low rise flats of concrete and brick construction. Retrofitted to the Enerphit standard using the Beattie Passive TCosy system. Innovate UK funded project.

Location: Chelmsley Wood, Solihull, UK

Completion date: June 2016

Budget: £625,000

Passive house certification: Enerphit certification pending

Space heating demand (PHPP): 24 kWh/m²/yr

Heat load (PHPP): 14 W/m²

Primary energy demand (PHPP): 121 kWh/m²/yr

Airtightness (at 50 Pascals): 0.93 ACH at 50Pa

Energy performance certificate (EPC): Pending

Measured energy consumption: Monitoring equipment in place will allow post-completion data to be compared to a year of pre-project data

Thermal bridging: Thermal bridging was eliminated by use of the TCosy system, with a continuous layer of insulation around the building. Insulation continued below ground and windows were installed in the insulation layer.

Ground floor: 150mm Concrete ground floor uninsulated as before. U-value: 4.082 W/m²K

Walls: Beattie Passive timber frame system, as below. U-value: 0.099 W/m²K

Above ground: Pre finished render board externally followed by battening, breather membrane, 50mm Kingspan Kooltherm K5 insulation, 12mm Versaliner, timber frame filled with platinum Ecobead, airtight membrane to existing masonry.

Below ground: 12mm plastic skirt, followed inside by battening, breather membrane, 50mm EPS insulation, 12mm Versapanel, timber frame filled with platinum Ecobead, Monarflex DPM membrane lapped with airtight membrane on existing masonry.

Roof: Beattie Passive timber frame system. Felt roof covering, followed underneath by 12mm plywood, 75mm EPS insulation, 12mm plywood, timber construction 220mm Ecobead insulation, air tightness membrane, 18mm plywood, 50mm wood wool insulation, on 220mm concrete. U-value: 0.1 W/m²K

Windows: Triple-glazed Elwiz Energio passiv PHI certified PVC window. U-value: 0.9 W/m²K

Entrance door: Fully welded stainless steel communal entrance door with an African close grain cedar core, including double-glazed argon filled sealed units. Glazing U-value: 1.1. Frame U-value: average of circa 4.3. There were some very significant thermal bridges as part of the construction of the door, which was chosen for secutity purposes. Care was taken to ensure the seals – rubber gaskets around the frame and the magnetic locking system – were as airtight as possible.

Heating system: 90% efficient individual gas boilers to each unit, supplying existing radiators

Ventilation: Heinemann Vallox KWL90 MVHR system. PHI certified heat recovery efficiency of 79%. Ductwork installed in insulation layer with MVHR units in external insulated cupboards accessible by the housing association.

Deep retrofit transforms big, complex South Dublin home

At first glance, this sprawling house in Blackrock would appear to be a nightmare candidate for a deep energy upgrade — large and sprawling, and with a mix of structures built at different times and with different materials. But guided by the passive house standard, the team behind it managed to turn a G-rated energy guzzler into a healthy and very-low energy family home – complete with an A rating.

Words: John Hearne

Photos: Paul Tierney

Any builder will tell you that when it comes to refurbishment, you never really know what you're dealing with until you start opening up the structure. Greenfield builds need careful planning and attention to detail. Retrofits need that, plus imagination and an ability to think on the hoof. A Zen-like calm would also be helpful.

When architect Brendan O'Connor of Abode Design set out to extend and retrofit the Regan family's sprawling home in Blackrock, Co. Dublin, the list of unknowns was substantial. The house itself was 60s era, and probably of hollow block construction, while a 70s era extension on the eastern façade also seemed to be hollow block. Then there was a 'cottage' annex to the right, which had a stone façade and merged with an old garden wall. It was anybody's guess what lay beneath the stone.

The house was also very big at 370 square metres, and warren-like in its layout. "The original house had charm," says O'Connor, "but the actual flow and connection of spaces just didn't make sense at all. You had to go up and down stairs from one bit to another, and it didn't really make sense. It had been tinkered with over time rather than properly considered, so the brief I was given by the client was to put manners on that higgledy-piggledy nature."

The client, Pam Regan, also had very clear ideas about the kind of retrofit she wanted for herself and her family. When asked why aim for a sustainable low-energy spec, she asked, why not? "Why wouldn't you in this day and age? It would be silly not to. It wasn't a big

decision, it was the only way to go.”

The problem however was that the house was an affront to sustainable principles. Big where it should have been small, sprawling where it should have been compact, and built with little or no insulation. It was also, she says, very cold.

This left Brendan O’Connor with twin challenges. In addition to rationalising the rambling layout and creating a bright, open space more suited to the needs of the family, he also had to transform the house into a warm, comfortable, healthy home without compromising the charm that drew the Regans to it in the first place. O’Connor chose Enerphit, the passive standard for refurbishments, as his guide. This was familiar territory for O’Connor, who was project architect for Ireland’s first – and the world’s 5th – certified Enerphit project, just around the corner at Wynberg Park, while at Joseph Little Architects (a project which featured in issue two of Passive House Plus.

“We were aiming for the most efficient construction and in my view, the principles and targets of passive house are very sound,” he says. “You don’t have to purchase expensive systems to create energy efficiency. Instead, you ensure the envelope is highly insulated and thermal bridge free, airtightness is good, and that you have a ventilation system to keep everybody healthy.”

“Those are excellent principles, no matter what building you’re working on, and those are what drove this project.”

The existing two-storey extension on the eastern elevation was judged to be substandard, and was demolished, to make way for a structure of much higher build and thermal quality. Internally, the team stripped out the existing floors and replaced them with a new concrete slab, making it possible to move freely through the ground floor without the need for steps. Internal walls were removed and the design opened up, introducing light deep into the heart of the house.

“This is a very active family,” says O’Connor. “They anticipated that the back door to the lane would be in constant use, so I had to design the house in such a way that it worked with both front and back. That informed the new entry point with the stairs and created a nice bright focal point.”

The ‘cottage’, as it was known, was a single-storey extension on the western elevation that backed onto the lane at the rear of the house. It was stone clad, and appeared quite old. When the structure was investigated however, that turned out not to be the case.

“It was all hollow block when we opened up; it was of very strange construction. We got the impression that it was old garden walls and that someone, at some point, decided to put a roof on it.” Rather than demolish the structure, the design team decided to remodel it and place the back entrance here.

Extensive use of external wall insulation (EWI) formed a central part of O’Connor’s refurbishment plans. Wrapping the house’s walls with a Baumit EWI system brought the U-values right down – 150mm bringing the existing walls to 0.19, with 200mm on the extension walls hitting a lower still 0.146. It also formed a central part of the strategy on addressing thermal bridging.

“With EWI, it’s quite easy to avoid thermal bridges, because you’re wrapping the house. Really, what you’re trying to do is make sure you meet the insulation in the roof, and that you’re near the floor insulation. You then ensure that the junction between the floor slab and the external wall insulation is of low conductivity.”

Specialist thermally broken products were also used diligently where required. Fischer Thermax fixings were used to affix rainwater systems to the EWI layer and Schöck Isokorb connectors were used where balcony and solar shade meet the external walls, in both cases keeping thermal bridging to a minimum.

Because of the thickness of the insulation, the windows sit proud of the masonry in order to avoid being lost in the reveals. Support comes from Compacfoam sole plates, a product similar to expanded polystyrene. It’s as dense and strong as timber, but its thermal conductivity is so low that the window reveals do not become thermal bridges, sucking heat out of the structure.

The bay windows on the front elevation were however a different matter. When the build team set about removing the old windows, they discovered that they were actually holding up the roof. This generated an immediate need for steel. Typically, says O’Connor, architects like to hide structural details like these in window mullions. That solution would however have introduced a

major thermal bridge to the design.

Instead, O'Connor asked the engineer to specify steel with the slimmest profile possible, and then placed that steel on the warm side of envelope, just inside the mullion.

"We painted it white to match the windows," he says, "and they appear to disappear into it. At the time however, there was a lot of debate over that. It's one thing to say that it will disappear, it's another thing to believe it."

The design team also sought materials that were fully breathable in order to make sure that the structure could deal effectively with moisture in the build-up.

"The minute you put on membranes and insulation, you're either stopping heat getting to structures, which probably means condensation can happen, or you could be trapping vapour or wetness somewhere. Every time I trap something, I make sure that I've thought about ventilation, for the client and the structure, so both stay healthy."

Citing the fact that masonry buildings invariably retain moisture, the external wall was finished with a breathable render. O'Connor points out that a vapour tight render could prove a real problem. "The worry then is you have moisture build up under it, and that it might de-bond over time."

Asked what his strategy was for airtightness, O'Connor says that it largely consisted of getting a good builder onsite. Tim Walsh of contractors Brian M Durkan & Co says that achieving airtightness was unquestionably the biggest challenge the build team faced.

"Because we were working between old and the new, around existing structures, the attention to detail required to achieve the target was exceptional. Certainly our foreman had less hair when he finished the job than when he started it."

Despite the challenges that arose during the build, O'Connor says that there were no huge dramas onsite. "We had very good people. The builders were excellent, they asked questions early and gave us time to answer them. We worked together to find solutions. It's not like there weren't problems, but they just weren't dramatic enough to scar my memory. The foreman, Dermot Ryan, was particularly good and I had worked with him before on another challenging low energy retrofit and knew the project was in safe hands, and if anyone could meet the arduous airtightness target he could."

Gavin Ó Sé of airtightness consultants and testers Greenbuild agrees: "The role of the foreman, or other airtightness champion, is crucial on a project like this. Dermot's attention to detail and his ability to make the trades aware of airtightness throughout the build meant that the target could be achieved in spite of a very complex building."

The central plank of the airtightness strategy was the internal wet plaster finish. Airtightness membranes and tapes were deployed liberally around ceilings, with taping at window junctions too.

"If it was a new build," says Walsh, "you would deal with airtightness as you built, but you obviously can't do that with existing structures."

Walsh emphasises the importance of retaining personnel where possible, to keep continuity in terms of quality and delivery overall. "Dermot has been with us 15 years or more, as have many of the lads who work for us. Even many of the subcontractors we work with stretch back to similar periods of time." This means that once tradespeople have been upskilled for issues like airtightness, the knowledge is retained for future projects. For instance, Walsh points out that on the company's standard jobs now, if a subcontractor pierces a hole in the airtight layer, it's become ingrained practice for them to tell the foreman, with impressive results. "We're typically hitting figures of 1 to 2 ACH on new build projects, without being asked," he says.

In this project, the building achieved an airtightness result of 1.01 ACH – which is within the tolerance limits of the Enerphit benchmark, 1 ACH. Not that it matters. Given the size of the house, the widely dispersed footprint and the variety of materials in the structure, this is an excellent result by any measure.

It is however interesting to note that though the design and build team managed to hit this target, the house doesn't quite make the Enerphit standard, primarily because of the ventilation solution they implemented.

Typically, a mechanical heat recovery ventilation (MVHR) system is used in passive houses to deliver cold fresh air from outside, which is warmed using heat harvested from vented stale air. The passive house standard requires air supply to reach certain temperatures before entering the living space, meaning that MVHR systems are effectively mandatory in the northern European climate. These systems are built around centralised fans and extensive ductwork. The bigger and more complex the house, the more pipes you need. In a retrofit situation, charting a course for this pipework can be challenging, to say the least.

"The amount of ductwork to supply and extract meant that it would be quite invasive in the existing house," says Brendan O'Connor. "It was very hard to find sensible routes, so we decided to go with the demand controlled ventilation system."

Instead of one centralised unit controlling the flow of air though the entire house, individual spaces and rooms are fitted with fans that are humidity-triggered. Less power is drawn down because the system is not running constantly (as MVHR does), but because the heat recovery element is now gone, there is a slightly higher space heating requirement.

The Regan family moved in last July, so haven't yet had a winter to test the structure. Pam Regan says however that she couldn't be happier with it. "It's gorgeous. I love it. It's so bright and clean. I smile every morning when I get up and come downstairs." ▸

(above) the house was wrapped with a Baumit external wall insulation system, with VM Zinc roofing and Fakro DXF triple glazed roof windows; (below) internal walls were removed and the design opened up, and combined with the Fakro and Velux roof windows this introduces natural light into the heart of the house.

(above, clockwise from top) metal web Posi joists to intermediate floor of new extension; site works after demolition of an earlier extension; existing walls at lane to the read of the house, with the pebble dash wall in the middle forming of the building's thermal envelope; Intello membranes and airtightness detailing where the new roof meets the existing external wall.

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SELECTED PROJECT DETAILS
Clients: Pamela & David Regan
Architect: Abode Design
Main contractor: Brian M Durkan
Civil & structural engineer: Waterman Moylan
Chartered surveyor: RCQS
Mechanical contractor: Mountain Lodge
External insulation contractor: Ecoclad
BER: OTES
Cladding supplier & roofing: A+A Quinn Roofing
Thermal breaks (sole plates): Compacfoam via Partel
Thermal breaks (balcony/solar shade connection): Schöck Isokorb via Contech
Thermal breaks (fixings to EWI): Fischer Thermax via Masonry Fixings
Roof insulation: Isover
Floor insulation: Xtratherm
Airtightness products: Ecological Building Systems
Windows & doors: Velfac, via Teroco
Roof windows: Fakro via Tradecraft, Velux
Blinds: Window Fashions
Stoves: Dimplex, Scan, Stovex, via Heating Distributors
Radiators: Quinn
Ventilation (DCMEV): Aereco
Lighting: National Lighting
Posi joists: Armstrong Timber Engineering

(above) Installation of Velfac windows, while Schöck Isokorb connectors used where the balcony meets the external wall to minimise thermal bridging; Compacfoam sole plate under EPDM membrane supporting window cill in external insulation layer, to prevent thermal bridging

PROJECT OVERVIEW

Building type: 370 square metre detached house from 1960. Deep retrofit with low energy two-storey side and single-storey rear/side extension

Location: Blackrock, Co Dublin

Completion date: July 2016

Budget: N/A

Enerphit certification: N/A

BER
Before: G

After: A3 BER (73.66 (kWh/m²/yr)

Space heating demand (PHPP, after): 37 kWh/m²/yr

Heat load (PHPP, after): 16 W/m²

Primary energy demand (PHPP, after): 117 kWh/m²/yr

Airtightness: 1.01 ACH at 50Pa

New ground floor: New floors – in original building and extension – constructed with 200mm Xtratherm Thin R (thermal conductivity of 0.022 W/mK) under 175mm polished concrete floor. U-value: 0.144 W/m²K

Existing walls (before): Uninsulated 215mm concrete block walls

Existing walls (after): 150mm graphite EPS (0.031 W/mK)) on 215mm solid block wall with a wet plaster finish internally. U-value: 0.191 W/m²K

Existing boundary stone wall (after): 600mm random rubble block, 40mm cavity, 120mm Isover Metac insulation between studs @400cc, a 50mm service cavity (battens @400cc) insulated with Metac, and 12.5mm plasterboard internally. U-value: 0.208 W/m²K

Existing roof (before): Sloped with mineral wool insulation. Roof tiles to sloped areas and torch on felt to flat roof areas externally. 150mm mineral wool insulation on the flat between roof joists and a combination of suspended ceiling tiles or plasterboard ceiling internally. U-value: 0.333 W/m²K

Existing roof (after): New roof constructed with 150mm Isover Acoustic Roll between rafters @400cc with additional 200mm Acoustic Roll above. U-value: 0.123 W/m²K

Extension walls: Baumit EWI system with 200mm graphite EPS (thermal conductivity of 0.031 W/mk) on 215mm solid block wall with a wet plaster finish internally. U-value: 0.146 Wm²K

Boundary wall to side extension: 215mm solid block wet plastered internally, 25mm cavity, 120mm Isover Metac insulation between studs @400cc, a 50mm Metac-insulated service cavity (battens @400cc) and 12.5mm plasterboard. U-value: 0.213 W/m²K

New monopitch roof: Zinc externally, followed underneath by 18mm marine ply, a 40mm ventilated cavity, 18mm plywood, 250mm Isover Metac insulation between rafters @400cc, a 100mm service cavity (battens @400cc) (Metac insulation to service cavity) and 12.5mm plasterboard internally. U-value: 0.118 W/m²K

WINDOWS & DOORS
Before: Double-glazed PVC windows and doors. Overall approximate U-value: 3.50 W/m²K

New triple-glazed windows: Velfac 200 triple-glazed, argon-filled, aluminium windows with low-e coatings. Overall U-value: 0.8 W/m²K

ROOF WINDOWS
Fakro DXF triple-glazed flat roof windows, including 6mm thick toughened external glass with overall U-Value of 0.88 W/m²K.

Velux GGU triple-glazed roof windows with overall U-value of 1.0/m²K

HEATING SYSTEM
Before: 20 year old oil boiler & radiators throughout entire building.

After: Greenstar Cdi high-efficiency condensing gas Combi boiler and radiators throughout. Plus three (Scan, Dimplex, Stovax) room-sealed solid fuel stoves, each having no air exchange with the room and own air supply kit.

VENTILATION
Before: No ventilation system. Reliant on infiltration, chimney and opening of windows for air changes.

After: Aereco demand controlled mechanical extract ventilation system to the whole house.

Green materials: All timber furniture from PEFC certified sources, Tricoya to soffits and fascias. First fix completed for rain water harvest system which will capture rain water from most of the roof.

Photos: Denis Fahey

SuperHomes scheme:

a blueprint for cost-effective deep retrofit?

For a while now, schemes that aim to encourage the mass uptake of home energy upgrades — essential for cutting carbon emissions from our building stock — have tended to fall into two camps: those that focus on shallow measures like cavity wall insulation and new boilers, and deep retrofit like the Passive House Institute's Enerphit standard. A new Irish retrofit scheme aims to point the way forward by bridging the gap between these two extremes.

Words: John Cradden

For a number of years now, we've been trying to resolve the conundrum about how to stimulate deep retrofits of homes on a massive scale in order to reduce their carbon emissions in the most cost-effective way possible.

Better Energy Homes, the Irish government's retrofit scheme, has gone some way to stimulating the retrofit market from a very low base with its support for individual measures such as roof, cavity wall and external wall insulation, high-efficiency fossil fuel boilers, and heating controls.

But few would disagree that mass retrofitting in Ireland, as in the UK, has to go further and deeper. Part of the problem is the yawning chasm in the retrofit market between shallow projects driven by the Better Energy Homes scheme at one end, and high-end retrofits to the Enerphit standard on the other.

Into this gap has jumped a ground-breaking new national scheme called SuperHomes. Developed and run by the Tipperary Energy Agency (TEA) and funded by SEAI (the Sustainable Energy Authority of Ireland), it offers grant funding to cover up to 35% of the cost of upgrading pre-2006 homes to an A3 Building Energy Rating — up to a maximum eligible cost of €26,000 (excluding VAT).

Although an A3 BER is the upgrade target, SuperHomes also includes several mandatory measures that homeowners must complete to avail of financial support. The primary heating system must be renewable – and specifically an air-to-water heat pump or wood pellet boiler. Advanced ventilation systems must be installed, such as demand controlled mechanical extract ventilation or heat recovery ventilation. Finally, the building's airtightness must be improved. Other non-mandatory measures, such as insulation, window and door upgrades, biomass stoves and solar PV arrays may be incorporated.

The scheme is clearly aimed at people who want to do more than a shallow retrofit, but who also don't want to be using oil when there's a realistic renewable energy option. And it's all presented in a digestible, simple-to-understand package.

"There's no easy option and still there's a lot of confusion, a lot of challenges about [people] actually doing what they think they want to do from an ethical or environmental or comfort point of view," said TEA's chief executive Paul Kenny. "We developed SuperHomes around trying to answer that need."

The main lesson Kenny took from the spectacular failure of the UK's Green Deal retrofit scheme, he said, was that while the advice homeowners received was clear, it wasn't tailored to the individual property.

So the essential sales concept TEA settled on was to organise an extensive survey and then design a comprehensive, holistic scheme that incorporates the most appropriate measures for a home, present it to the homeowners and say 'this is what I would do'. Kenny said: "We make a grant offer to people based on what will work in their house and work for them."
At first glance, the technical design of a typical

SuperHome might read a bit like passive house lite, as two of the scheme's three mandatory measures bear the hallmarks of the passive house approach – mechanical ventilation systems and airtightness. The non-mandatory measures, while important, are chosen depending on how well they will fit together in the retrofit's proposed design, but also dependent on budgets.

The truth is that SuperHomes differs from a typical passive house approach, which "is really about 95% energy… use reduction mainly through building fabric measures, but for us its 20-30% reduction through fabric measures and another 20-40% through well designed, well commissioned heat pump use," said Kenny.

SuperHomes also operates according to the law of diminishing returns. When saving energy gets above a certain cost, it's just cheaper to generate it renewably, he says. "It's the cost of energy efficiency versus the cost of renewable energy. SuperHomes has been designed to achieve the balance there. And it's hugely challenging; most people have shied away from this type of thing."

Based on monitoring together with feedback from participating homeowners, TEA has fine-tuned the initial pilot scheme involving 10 houses and is now in the process of completing 27 more SuperHomes this year. The average net cost of the measures to the pilot homes was around €18,000 with the average payback period estimated at around 10 years.

And the feedback appears to be very positive, particularly regarding the comfort levels, which Kenny says is thanks to the combination of heating systems that are always on and windows that don't need to be opened for ventilation, meaning that the average temperature inside is higher. Not to mention the level of indoor air quality. Kenny said: "You have comments like, we no longer smell the dogs, we no longer smell the son's hurling kit, you know, all that sort of stuff. So you put that all into a mix and everyone is much happier with the solution."

SuperHomes residents also report reduced condensation, which Kenny says is thanks to the combination of higher air temperatures generated by the always-on heat pump together with the reduced humidity brought about by the demand control ventilation. At the same time, he adds that SuperHomes has shied away from internal insulation because of the higher risk of interstitial condensation.

Kenny is also keen to dispel some of the fears and preconceptions that some contractors might have about getting involved in SuperHomes because so much of the work might be new to them, such as airtightness, ventilation and heat pumps.

He said some of the contractors who pitched for work offered very uncompetitive quotes, presumably to mitigate what they perceived as some of the risks or uncertainty associated with retrofit work. But they are not expected to have much or any design input into a typical SuperHomes scheme, as this is the TEA's domain. All contractors undergo training on the key works measures too before they even get on a site.

Paul O'Brien of Sola Energy Solutions in Tipperary is a SuperHomes contractor. In the homes he has worked on so far, there have been no nasty surprises, and he likes how the scheme has helped take out much of the guesswork. "They make it very simple for us, we know exactly what we're pricing."

"The ventilation would have been new to us, none of us were trained up for that, but the heat pumps, we've some experience of installations but not for retrofitting." Having since worked with both demand control ventilation and heat recovery systems, he much prefers the job of fitting the former.

He also appreciates more now how the installation of the heat pumps is a job that requires particular care, particularly if it aims to continue its recent emergence as a mainstream choice in heating systems.

The pumps themselves are also becoming more of a commodity item, but there's still some way to go. "While it's not the cheapest in terms of a ten year payback – we need to scale it up to get it cheaper, and incentivise its uptake," said Kenny.

As well as the UK's Green Deal, the TEA researched comparable retrofit schemes in other countries, including Germany's development bank KFW's energy efficient refurbishment scheme, and an eco-renovation scheme in Picardie, a rural area just south of Paris.

The KFW scheme has a number of stand-out features, including the all-important whole house approach to energy saving, but it also benefits from state-subsidised loans available at eye-poppingly low interest rates of between one and two per cent. If SuperHomes goes national — as is Kenny's aim — getting the cheap finance conundrum cracked will be crucial.

"It needs a lot of work to make it national, but it's viable and we're clear on that," he says. ▶

(above, top to bottom) Aereco demand-controlled mechanical extract ventilation units have been installed on all SuperHomes projects to date to guarantee indoor air quality and protect occupant health. Fresh air enters through external grilles; EHT humidity sensitive air inlets modulate the ventilation rate subject to occupancy; the stale air is extracted through variable airflow BXC extract units.

Case study 1: Charles Stanley Smith

Charles Stanley Smith and his wife live in a two-storey detached house built in 1993, and through the SuperHomes scheme he got the mandatory air source heat pump, demand control ventilation, airtightness, upgrades, along with new lower temperature radiators, cavity wall insulation, and the insulation of the attic space and flat roof. He also got the chimney permanently closed and the gas fire disconnected, and later had PV panels installed.

Like many environmentally-conscious homeowners, he had been keen to get his draughty house retrofitted for sometime, but was driven to distraction by the difficulties in researching individual measures and finding out what grants were available.

This made the tailored yet flexible approach provided by SuperHomes something of a panacea for Charles and his wife.

"In some ways it's much easier to have somebody else to explain that to my wife than me, because she's getting a better view. I could have sat her down and said 'the results of my googling are...' but to have Paul [Kenny] come along and sit both of us down and go thorough our requirements together, was very reassuring for her."

This extended to the business of getting a loan without having to pitch the merits of the scheme to AIB, which had agreed to provide finance to anyone who wanted a SuperHomes retrofit.

"A lot of my friends would like to do this because it's too complicated trying to do it on your own… To have Paul come in and say, here's your answer, all you have to do is sign here, and sign the cheque at the end of the day, was great. And you have absolute involvement in the whole thing."

Previously a heavy user of oil and electricity for heating and hot water, he reckons he saves as much as €2,000 on his heating bills each year now.

(above) a house in Templemore, Co Tipperary that received three new air-to-water heat pumps, an Aereco demand-controlled ventilation system, 4kW solar PV array and airtightness measures under the SuperHomes scheme. The house achieved an airtightness test result of 5 air changes per hour; (below) homeowner Charles Stanley-Smith, whose house was also upgraded under the programme.

Case study 2: Seamus Hoyne

Before he learnt about SuperHomes, Seamus Hoyne – Kenny's former boss at Tipperary Energy Agency – pretty much knew what needed to be done to bring his split-level bungalow to the energy-efficiency standard that he wanted.

Located in a rural area near Roscrea, Co Tipperary, the bare shell was built in 2005 but later abandoned due to the recession until Seamus and his family bought it in 2008 and finished it off. As part of this fit-out they installed solar thermal panels, a double-sided wood stove and did some insulation upgrades, but they wanted to do more.

"In principle, we want to do a comprehensive upgrade and knew that we had to do some work on ventilation and also on our windows and back door.

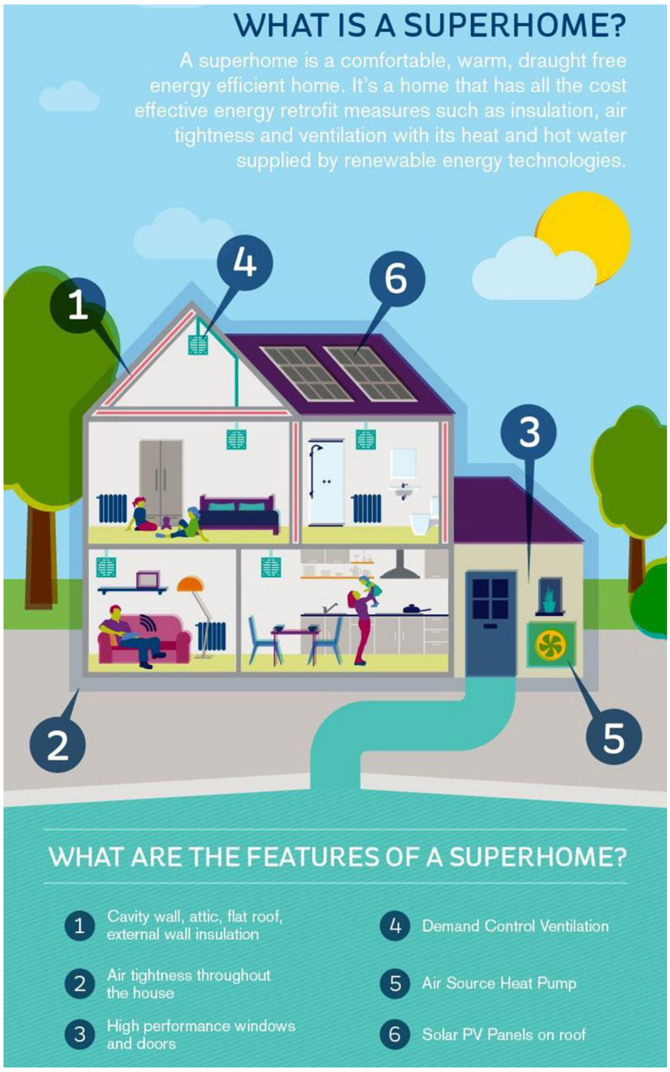
When the SuperHomes pilot scheme came along, it seemed to tick all their boxes and proved to be the incentive the family needed to actually get it done, said Seamus.

For a total investment of €17,000 (funded without a loan) of which 35pc was subsidised by the TEA, the Hoynes got the mandatory

air source heat pump, demand control ventilation and airtightness upgrades, along with a new back door and triple-glazed windows. PV and external insulation were also on the wish list but ruled out due to the limited budget, though they hope to get PV in the near future.

Seamus is delighted with the comfort levels of the home. "Our split level bungalow has the childrens' bedrooms in the low part of the building. There were emerging condensation issues and ventilation issues and the kids tended not to spend time there. The move to a low temperature heating profile in the building along with the ventilation upgrades has made this part of the home much more comfortable."

Working out the savings in running costs is still a work in progress, but having previously spent around €230 a month on heating fuel (oil and wood), the heat pump is now costing €80 a month. So, along with reduced use of the wood stove, it looks like they are already saving well over €120 a month. Seamus expects a payback period of about nine years.



How SuperHomes was born

How SuperHomes came about and how it arrived at its particular retrofit model is an interesting story in itself. It began when Tipperary Energy Agency ran an EU-funded project called Serve (Sustainable Energy for the Rural Village Environment) from 2008 to 2012 that aimed to create a sustainable energy region in North Tipperary, part of which involved designing a successful retrofit programme for residents.

While they ended up doing some 1,400 mainly shallow retrofits under Serve, Kenny and his team were frustrated that houses upgraded under the programme didn't go completely renewable. In planning its next retrofit scheme, the TEA resolved not to support oil boiler installations.

When they started looking more closely at domestic applications of air-to-water heat pumps, they were repeatedly warned off them for being too expensive or, because they needed low-temperature emitters (like underfloor heating) to work properly. But on realising that 20% of Sweden's domestic heating is provided by heat pumps, and that they are common in the US, Kenny says "we thought to our ourselves, there must be a way".

It was then that airtightness came into the equation. The theory goes that if you run heat pumps like boilers – cycling on and blasting high temperature heat in for a couple of hours, then cycling off – they won't be very efficient. But if you use them for 24 hours, you can bring the temperature down and slash the energy consumption accordingly, but only if the house is airtight.

"So we thought, well we have to bring down the air leakage so that if we do extend the heating period using a heat pump, we won't drive the energy consumption bananas."

So they arranged to experiment with basic airtightness measures on five houses, including Kenny's own home. "Our houses would have started between 9 and 14 air changes an hour and they came down to between two and five essentially. So you could probably say from an air leakage point of view we took 50-70% of the air leakage out of houses," he said.

"And then we thought, if we bring the airtightness down we are not going to have enough fresh air, so we are going to have to do ventilation as well."

More research followed, spurred by Kenny's personal interest in better air quality, and this led them to focus on mechanical ventilation, with demand control ventilation systems emerging as a cheaper and more straight-forward option for retrofit than heat recovery ventilation systems.

But if these are the mandatory measures, how do the non-mandatory measures fit into the equation, including insulation, window and door upgrades, PV panels etc?

This is where the homeowner has a degree of choice, says Kenny. "For example, if they have an exposed stone wall that's 700mm thick in one part of the building but they really can't insulate for one reason or another, for aesthetics or that it would ruin the character of the house, then we can do other things to make up for that. That might be fitting a much larger radiator to get higher efficiencies. We're very, very flexible about how those solutions can be provided."

Armed with its new retrofit model, the TEA pitched a pilot scheme of ten homes last year to SEAI, including a 10% unsecured loan from AIB and a whole lot of metering, and SuperHomes was born.

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Help Desk

How to prevent condensation & mould

In this first instalment of his brand new 'Help Desk' feature, architect and passive house designer Simon McGuinness of Dublin Institute of Technology invites questions on all aspects of passive house, retrofit and low energy building.

"What can I do about the mould on my walls and ceiling?" I was asked by a member of the audience at a recent public meeting. My first response was to ask when it was built. Had it been a new house, or a recently refurbished one, my answer would have included a suggestion that they seek legal advice.

This is the regulatory minefield we, as designers of buildings or retrofits, now walk. So the topic I wish to explore today is how to ensure that we avoid liability, should mould appear in any of our buildings. And yes, I am constructing a legal defence, because I believe that a legal defence is going to be required, particularly in Ireland.

We live in a culture where mould in buildings is normalised. That culture tells us that it's the occupant's fault: they're drying clothes on the radiators, or they are taking baths and not opening the windows, or they're not turning on the central heating. Any number of excuses are offered, but the attitude persists that it is definitely not the designer's fault. That culture is changing.

There are two main causes of mould in otherwise healthy buildings: bad fabric design, and bad operation/use. The designer of a building — be that a qualified building professional, or an unqualified person acting in that role — is responsible for the first of these. The requirements of building regulations on both sides of the Irish Sea are clear, and derive from the same international standards. BS 5250:2011 states: a surface temperature factor of not less than 0.75 is considered to be sufficient to avoid mould growth, given the range of conditions in UK buildings and the UK climate (p86).

The means of implementing the standard is very different in each jurisdiction, with assigned designers carrying significantly greater risk in the Irish Republic as a result of the insured self-certification regulatory model. The Irish Technical Guidance Documents are also less proscriptive and more focused on ISO Standards to define surface temperature factor compliance.

In the UK, Approved Document C seeks to establish minimum acceptable U-values for planar elements as a means of satisfying the requirements and use of Accredited Construction Details as a means of limiting surface condensation at junctions. In Ireland, there is a national register of thermal modellers who are there to certify bespoke constructions beyond the scope of ACDs, or manufacturers' certified details.

The surface temperature factor defines the limit of the building designers' responsibility. Designers should embrace and apply it, as it gives them a clear way to limit their liability for mould, should it appear in one of their buildings. Unfortunately, this has yet to happen.

Few building designers have heard of surface temperature factor, fRsi, let alone how useful it may prove to be in protecting their professional indemnity cover. This must change, preferably before a change is forced by a wave of damages awards secured through the courts. Earlier this year we saw a claim of €52,000 (£45,000) settled in advance of the court for health impacts and personal damages caused by mould in one Dublin City Council maisonette. This sum was no doubt dwarfed by the need to rehouse the family, refurbish the offending dwelling and pay legal costs. It is not hard to calculate that the total liability accruing in such a case could be as much as €150,000 (£130,000).

> "We live in a culture where mould in buildings is normalised."

Affinity Solution Ltd's 2013 study of 102 retrofits, representative of 76% of English housing, indicates that incidences of mould, damp and condensation following retrofitting far exceed the baseline English House Survey's 6% incidence. The implication is that mould risk may actually be increasing as a result of energy retrofitting. Reducing air leakage, insulating the easy flat bits of walls, floors and ceilings but failing to address thermal bridging (the grant-aided solutions favoured by both governments) increases the risk of mould forming at the difficult junctions. This approach actually drives condensation towards the weakest points in the construction. And those points are predictable: they are where the surface temperature factor is less than 0.75.

It is time to embrace fRsi, time to learn what it means in practice, and how to manage it. Designers may even begin to sleep soundly at night, content in the knowledge that they have done their bit to prevent mould forming in their buildings. Others have their role to play too, but so long as you can point to a temperature factor calculation showing compliance, the design will not be at fault.

So what is a temperature factor? Temperature factor is a deceptively simple concept perhaps best explained by a simple example. It's a frosty winter's night and the air temperature outside is 0C. It's toasty warm inside with the ambient air measuring 20C. The thermometer hanging on the inside of the external wall reads 16C and the wall feels slightly cold to the touch.

The surface temperature factor is established by dividing the measured surface temperature (16C) by the difference in temperature between the inside and outside ambient air (20C). This gives us a surface temperature factor, fRsi = 0.8. This exceeds the minimum acceptable, or critical, surface temperature factor, fRsi = 0.75, which is required in most buildings to ensure that condensation will not occur on a surface (if the building is being operated correctly). In some buildings, like swimming pools, a higher temperature factor is required to meet the standard.

So, you might well ask if all it takes is three on-site temperature measurements, what's all the fuss about? If you can arrange for exactly 0C outside for a few days and ensure exactly 20C is maintained by the heating system over the same time period, then your on-site surface temperature measurement will be reasonably accurate.

But real life is not like that and buildings live in a dynamic environment, internal and external temperatures fluctuate, sunshine hits the façade. Similarly, thermal conductivities and thermal mass influence heat flows through the construction, in three dimensions. Consequentially, we have to resort to modelling heat flow using digital simulations. You have now entered the specialist world of the thermal modeller, and may need to buy in their services to prove compliance.

Want to ask Simon a question? Email ***helpdesk@passivehouseplus.ie***

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